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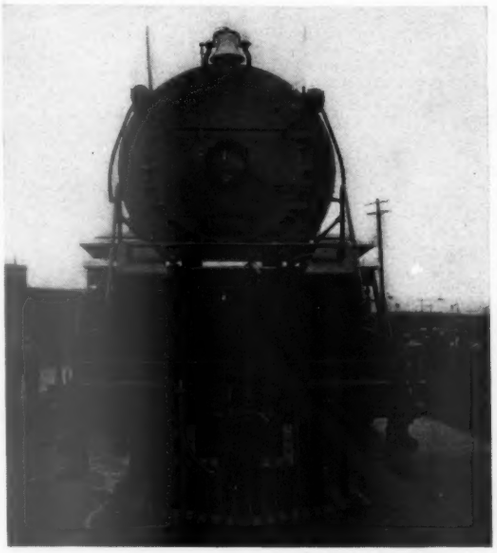

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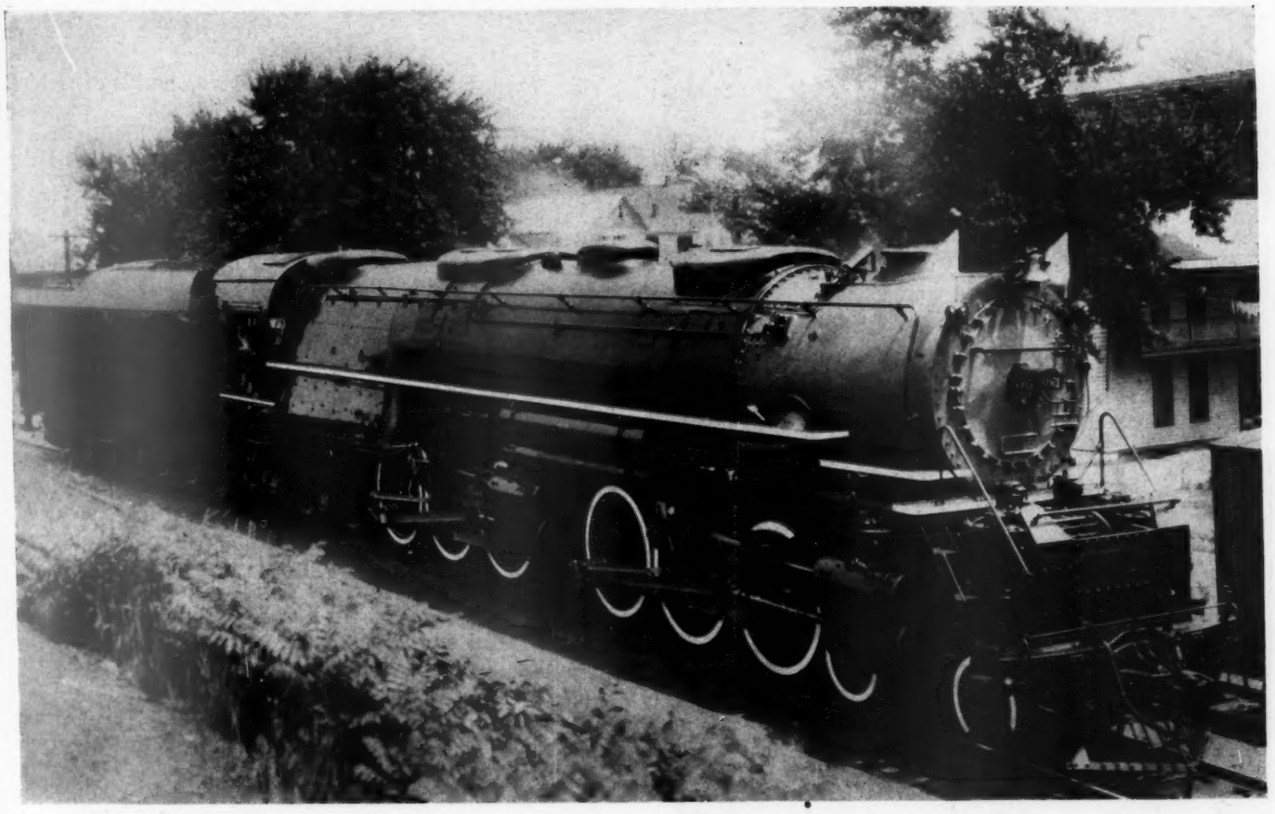


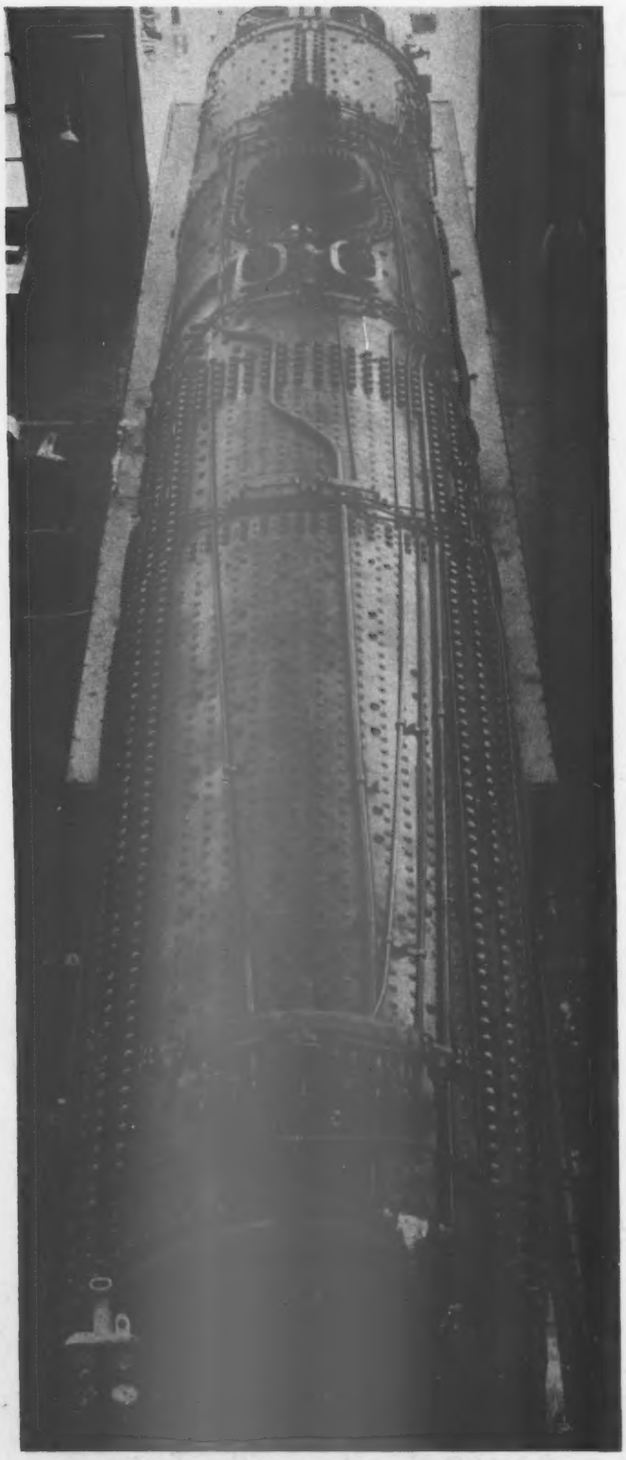
Alco builds

Twenty D. & H. Locomotives

Single-expansion 4-6-6-4 type are for fast freight service — With starting tractive force of 94,400 lb., they will effect a material reduction in double heading and helper service on a line with 1.5 per cent maximum grades

TWENTY articulated-type locomotives are now being installed on the Delaware & Hudson for high-speed, heavy freight service between Wilkes-Barre, Pa., Binghamton, N. Y., and Mechanicville, N. Y. These locomotives, built by the American Locomotive Company, are of the 4-6-6-4 type and produce a calculated tractive force of 94,400 lb. with 69-in. driving wheels.

The weight per driving axle was limited by the specification to 68,000 lb., a total specification weight allowance on drivers of 408,000 lb. The actual weight on drivers is 406,500 lb. It was further specified that the weight on the front engine was to be adhered to when the locomotive was on a 1½ per cent ascending grade. In order to accomplish this, the weight on drivers was distributed to bring more weight on the front engine than on the rear. The actual weight on the front engine drivers is 205,500 lb., while on the rear engine drivers it is 201,000 lb. The excess weight on the front engine drivers is provided to overcome slipping tendency of the front engine when ascending grades due to the surge of the water in the boiler toward the rear and other causes which reduce the adhesive weight on the front engine.



The Boiler

The boiler is of the straight-top type, 94 11/16 in. inside diameter at the first course and 102 in. outside diameter at the largest course. Barrel courses and welt strips are of Lukens carbon steel. The Elesco type A superheater has 60 5½-in. No. 8 flues of National seamless steel and 222 2¼-in. No. 12 Electrunite tubes 22 ft. long. The heating surface of the flues is 1,892 sq. ft.; of the tubes, 2,864 sq. ft., and of the superheater pipes, 1,681 sq. ft.

The firebox has a horizontal mud ring and is of welded construction, 213 1/32 in. long inside by 108 3/16 in. wide inside, with a combustion chamber 94 in. long. It has a grate area of 108 sq. ft. The heating surface of the firebox is 556 sq. ft. and that of the arch tubes 77 sq. ft. Soft coal is burned on Firebar grates fed by a Standard HT type stoker, with engine on the tender. Fire doors are Franklin No. 8. The American firebrick arch has a vertical transverse wall. It is supported on five National arch tubes 4 in. outside diameter, ¼ in. thick, which have their front ends secured in a special design thimble. Huron washout plugs and Okadee blow-off cocks are used.

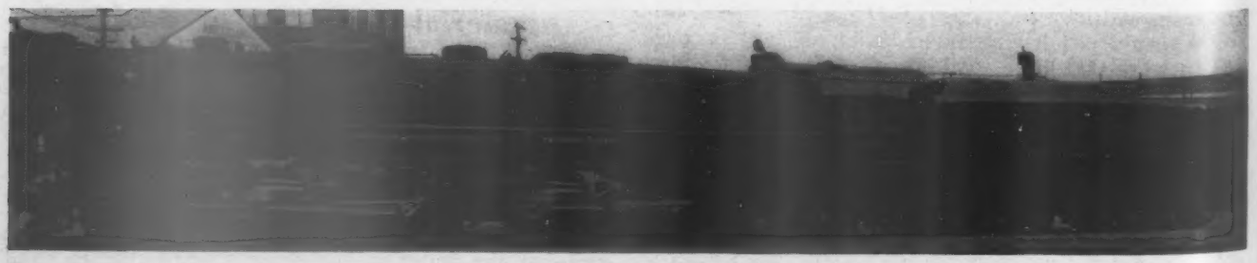
The flexible staybolts are of the Alco welded-sleeve type, of which there is a complete installation in the combustion chamber and throat sheet, except in the bottom row and in the breaking zones of the side sheets. Alco crown, radial and expansion stays are also used. Flexible stays of Ewald iron are on all of the engines, but hollow and solid staybolts of Ulster iron are on 19 of the locomotives while for one locomotive Lewis iron is used. Flexible staybolts coming inside of the cab on the back head and sides of the firebox are of the large-head, two-piece Flannery type, hollow drilled up to the head. Where flush flexibles are required, they are the small-head Flannery type.

The boiler is fed by one Hancock non-lifting type 3-W injector of 10,000 gallons' capacity located on the right side, and one Elesco No. 3 exhaust-steam injector of 12,000 gallons' capacity located on the left side. Delivery is through a Hancock twin top boiler check.

The smokebox netting arrangement is to the A. A. R. latest recommended practice, using No. 393 Draftac netting. The smokebox door is of sufficient size to permit the removal of the superheater units. The headlight is inset in the smokebox door.

The exhaust nozzle is of the Sweeney type and the smoke stack is straight, 26 in. in diameter, with the railroad company's standard shape at the top.

A steam circulating nozzle for admitting steam from the enginehouse steam line to the cold boiler is applied in the bottom of the first course near the front tube sheet. This directs steam toward the back of the boiler to promote circulation and obtain a more nearly uniform temperature all through the boiler, thus reducing the expansional stresses when firing up. Leveling brackets



A freight locomotive built by the American Locomotive Company which develops 94,000 lb. tractive force—The driving wheels are 69 in. in diameter

are applied to the left side and across the back head of the boiler, defining the center line longitudinally and transversely for checking the water level.

The Engine Beds

Both the front and back engine units are equipped with General Steel Castings Corporation frame beds with cylinders cast integrally. Back cylinder heads, guide yoke, valve-gear supports and air-pump supports are also integral parts of this casting.

The articulation hinge comprises a massive tongue cast on the rear of the front engine-bed unit, fitting into a cavity in the front end of the rear engine-bed unit. Bushings for the articulation pin are casehardened and ground, and hard steel wearing plates are applied above and below the hinge tongue. There is only $\frac{1}{32}$ in. clearance between the 8-in. diameter hinge pin and its bushings and only $\frac{1}{16}$ in. clearance between the wearing plates under the bottom of the hinge. Part of the weight of the rear engine unit is transmitted to the front engine unit by reason of its resting on top of the articulation hinge tongue. In the top of the hinge pin is a depression forming an oil reservoir covered by a dust cap and fed by mechanical lubrication so that oil spills down along the surface of the pin. The wearing plates on top of the tongue, which are in contact by reason of the load they carry, are grooved for oil fed from another lead from the mechanical lubricator.

By transmitting the weight of the boiler at two points on the front frame structure—namely, the main boiler bearing and the articulation hinge—perfect stability of the front frame structure is afforded with no tendency to rock as when only the main boiler bearing is the weight transferring means. This requires, however, that the spring rigging must be built with a maximum of flexibility and the engine truck equalized with the spring suspension of the front engine unit.

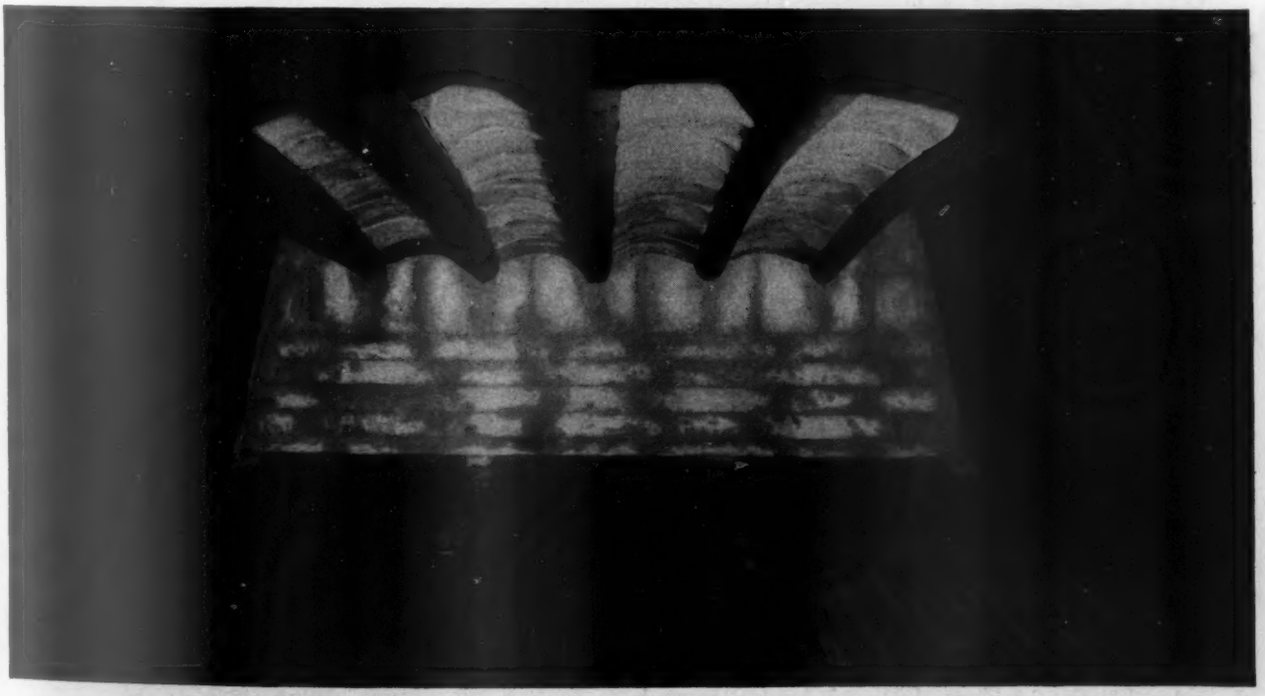
The Running Gear

The driving wheels are of the Alco Boxpok type. The main wheels are the rear pair on each unit and

The Elesco exhaust steam injector is located under the left side of the cab—The cab is supported from the boiler

are the only pair which are cross-counterbalanced. The reciprocating weights per side amount to 1,695 lb. on the front unit and 1,540 lb. on the rear unit. The overbalance is uniformly distributed over the three wheels on each side of each unit and amounts to 172 lb. per wheel on the front unit and 157 lb. per wheel on the back unit.

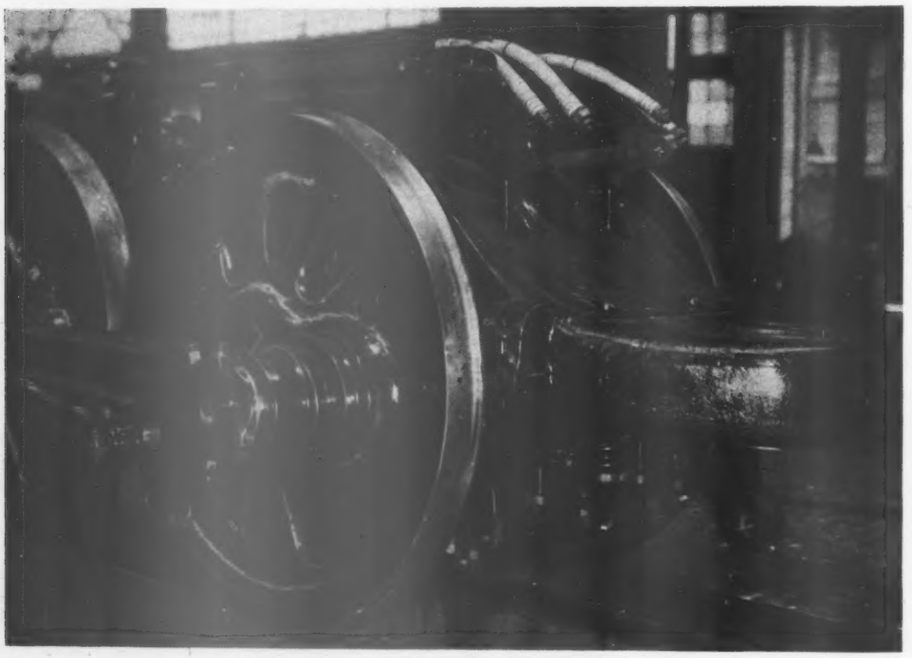
The main driving axles of each unit are fitted with SKF roller bearings, while the other two pairs have plain bearings. On the plain-bearing driving boxes and trailer boxes bronze hub faces are formed by depositing Herculoy fusion rod, and the driving boxes are equipped with Franklin No. 8 grease lubricators and spreaders. To the front driving axle of each unit an Alco lateral driving-box cushioning device is applied.



The firebox showing the brick arch, the fire wall and the Firebar grate

This permits ½ in. lateral movement on each side. The initial resistance of the lateral cushioning device on the front unit is 17 per cent and that on the rear unit is 8 per cent.

The locomotives have Alco geared roller centering-



The hinge at the rear of the front engine unit is an integral part of the engine bed

device engine trucks providing 4½ in. swing each side of the center, with an initial resistance of 17 per cent, increasing through the first two inches of lateral movement to 33⅓ per cent and continuing constant throughout the remaining lateral-motion range. SKF roller bearings are applied to the engine-truck axles. The top halves of the bearing housings are connected transversely, while the lower halves are separate.

The trailer truck is of the General Steel Castings Delta outside-bearing type. The front trailing-truck axle boxes have a lateral movement of 1 in. each side of the center and are fitted with the Alco centering device giving 10 per cent resistance throughout its travel range. The swing of the trailing truck is 8¾ in. each side of the center. The initial resistance is 9 per cent, but builds up gradually to 17 per cent which is constant through the remaining moving range.

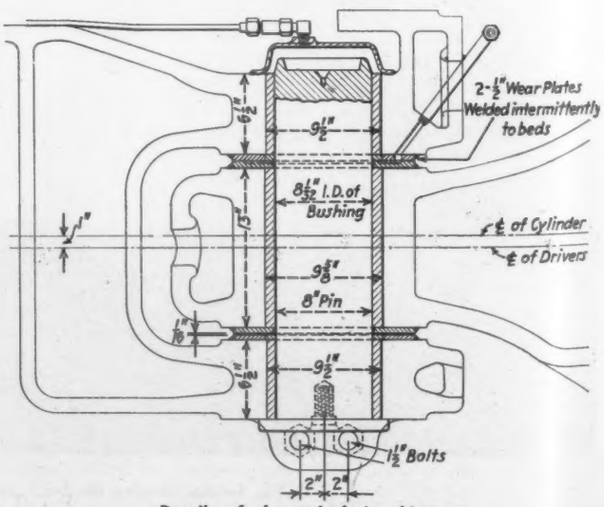
The shoes and wedges are of bronze. Franklin automatic wedges are applied to all driving boxes, except the main.

The pistons are of the box section type, made of Hunt-Spiller gun iron with Hunt-Spiller sectional duplex packing, one bronze and one gun-iron ring. Cylinder bushings and valve-chest bushings are of Hunt-Spiller gun iron. Paxton-Mitchell packing is used on both the piston rods and the valve stems. Head-to-head clearance front and back is 5/16 in.

Crossheads are of the Laird type and are arranged with the Becker design of wrist pin, removable from the outside. Side and main rods are of carbon-nickel steel, normalized, quenched and tempered. Alemite lubrication is provided for all pins, the fittings being applied in the builder's design of internal grease cavity which uses Whitworth threads for all holes tapped in the rods. Floating bushings of Magnus bronze are used on all crank pins.

Walschaert valve gear is used with trunnion design of links and special lightweight design of eccentric cranks attached to the main crank pins with two bolts each. The eccentric rods are channeled on the outside to within 12 in. of the front ends. Alco Type G reverse gear is used with 10-in. cylinder and is connected to the reverse-shaft arm of the rear engine. The reach-rod connection to the front engine is made by a rod extending forward on the center line of the locomotive. A crosshead operating in a cylindrically shaped guide fitted into the rear cylinder saddle contains a vertical pin located exactly in vertical alignment with the articulation hinge pin to take care of the lateral swing of the front engine unit. The twelve-inch piston valves have 7½ in. travel, 3/16 in. lead, 1¼ in. lap. The exhaust clearance is line and line.

Great care was exercised to obtain free passage for the steam through the cylinders. The area through the valve-bushing ports when the piston is at the end of the stroke is 38 sq. in., or 11½ per cent of the piston area.



Details of the articulation hinge

Through the cylinder port the area is 34 sq. in., which is 10.3 per cent of the piston area. The clearance volume of the cylinder is 9.3 per cent.

Steam pipes are of the builder's latest non-spreading jack-knife design. An elbow with a bottom outlet on each side of the smokebox divides and directs the steam flow to the front and rear cylinders. The arrangement leading to the front cylinders is a jack-knife type, the ball joints of which provide universal movement. Soft packings are used at the cylinder connection only. All joints are mechanically lubricated. Above the steam chest of the rear cylinders the steam pipe terminates in a balanced slip joint, the slip pipe being ported and packed on both ends with Sea Ring packing. The exhaust from each of the rear cylinders extends forward in a pipe which joins on a Y-fitting at the nozzle base. The exhaust pipe from the front cylinders has the usual ball joints front and rear with a ring-packed slip joint.

Steam enters the drypipe on one locomotive through the Tangential steam dryer and on one locomotive through the Dri-Steam separator. The remaining locomotives are so designed that ready application of either type can be made.

Spring Rigging and Equalization

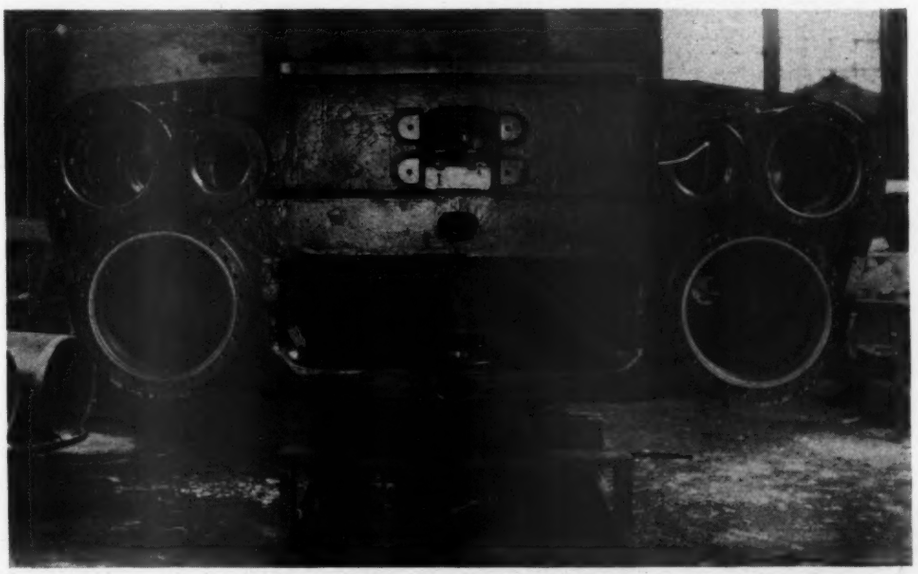
The springing of the engine truck employs the parallel spring suspension wherein one-third of the load is carried on semi-elliptic springs and the remaining two-thirds on coils. This permits the use of a much shallower and, therefore, a much more flexible semi-elliptic damping spring, while the initial shocks are absorbed by the coils, which promotes more flexible and smoother riding qualities.

The spring rigging and equalization system are shown in one of the drawings. The driving springs are all seated on rollers with cushioning coil springs at the dead ends of the system. The rear end of the forward equalizer rests on top of a spring seat extending between two vertical hangers and bearing on coil springs. Split, shouldered bushings surround the front ends of the coil-spring hangers and rest on collars formed on their lower ends. Since these coil springs cannot be located on the center line of the frames, their hangers are attached to transverse equalizers and, except at the rear end of the forward equalizer, these coils are located just as near the inside of the frames as possible. At the front and rear ends of the spring suspension system of the rear engine unit these cushioning coil springs are arranged in tandem to give greater vertical flexibility.

No gib connections are used at the upper end of the driving- and trailing-truck spring hangers, but instead they are looped over steel castings resting on the spring end clips. Fabreeka inserts ¼ in. thick are placed under all elliptic spring end clips. All spring-rigging pins and the under sides of all loop hangers are Alemite lubricated.

Lubrication

The front engine is fitted on the right side with a Nathan DV-7 36-pint force-feed lubricator, feeding valve oil to the cylinders and valves, guides and steam-pipe ball joints (front). On the left side is fitted a Detroit force-feed lubricator feeding car oil to shoes and wedges of all pedestals, driving-box hub faces of the first two axles, flange lubricator on the front drivers, engine-truck center plate and engine-truck centering-device gear racks.



The articulation hinge pocket in the front end of the rear engine bed

The rear engine is fitted on the right side with a Nathan DV-7 36-pint force-feed lubricator feeding valve oil to the throttle, steam-pipe ball joints (back), cylinders and valves, guides and stoker. On the left side is a Detroit force-feed lubricator, feeding car oil to the articulation hinge pin, main boiler bearing, flange lubricator on front drivers, radial buffer, all shoes and wedges on the rear engine, driving-box hub faces on the first two axles, and trailing-truck fulcrum pin.

Alemite lubrication is arranged for on all brake-hanger and spring-rigging pins, throttle rigging, bell, engine-truck pedestal shoes, the bearing points of the forward equalizer, exhaust-pipe joints, drawbar pins, rod knuckle pins, steam-pipe extension joint at rear cylinders, and reverse-gear connecting rod.

Wick-feed oilers are applied to the link trunnions and valve-rod cross-heads on top of the valve-stem guides to lubricate the top pins in the combination levers.

The Cab

The cab is supported entirely from the boiler by the builder's design of cab support and is not connected in any way with the frames. By this means the cab travels

The four-wheel engine truck is cross-equalized with the driving wheels on the front-engine unit—The top halves of the engine-truck journal boxes are joined in a single casting

and a manifold-type fin-tube radiator. Sump reservoirs are placed one between the coil and the radiator and one between the radiator and the main reservoir. Into these drains the water precipitated from the air passing toward the main reservoir. An automatic drain valve opens a drain from the bottom of each sump reservoir for a brief measured time interval on each occasion that the locomotive brakes are applied, thus preventing the accumulation of water and its possible reabsorption into the air flow.

Ten of the locomotives are equipped with King type sanders, and ten with Graham-White sanders. All of the locomotives have Graham-White spreaders which are designed to keep the sand traps clear.

Tender

The tender frame is the General Steel Castings Corporation water-bottom type and the tank is of the rec-

The Becker wrist pin is applied and held by gib and wedge from the outside of the crosshead — The headlight turbo generator is mounted under the running board

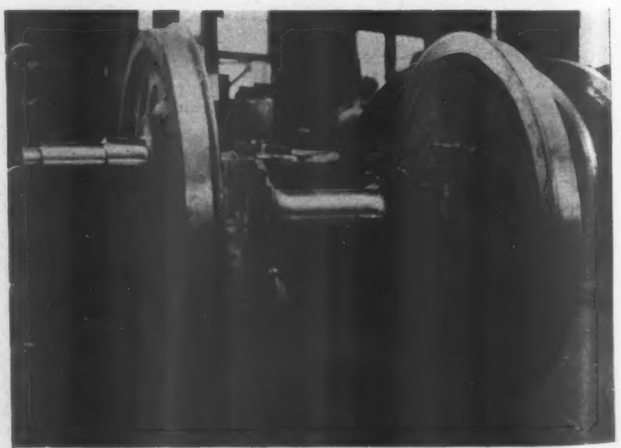
with the expansion of the boiler and no connection to the frame is subjected to movement at one end while being rigidly attached to the other. The cabs are particularly large and roomy. On the left side, back of the fireman's seat, there is a seat for the brakeman, while on the right side back of the engineman's seat is a clothes locker for the crew. The gages on the fireman's side are combined in a case having concealed illumination and through which air is circulated. A pipe extends above and below this case. At the bottom of the lower or intake pipe are right-angle bends front and rear to collect a current of air when running either forward or backward. The pipe extending from the top of the case terminates beneath the cab roof and is the outlet for this upward current of air.

Brakes

Brake operating equipment is New York schedule 8ET with two 8½-in. cross-compound compressors located on top of the frame ahead of the smokebox and operated by superheated steam. Neither the engine truck nor the trailer truck has brakes.

The air-cooling system includes a primary cooling coil

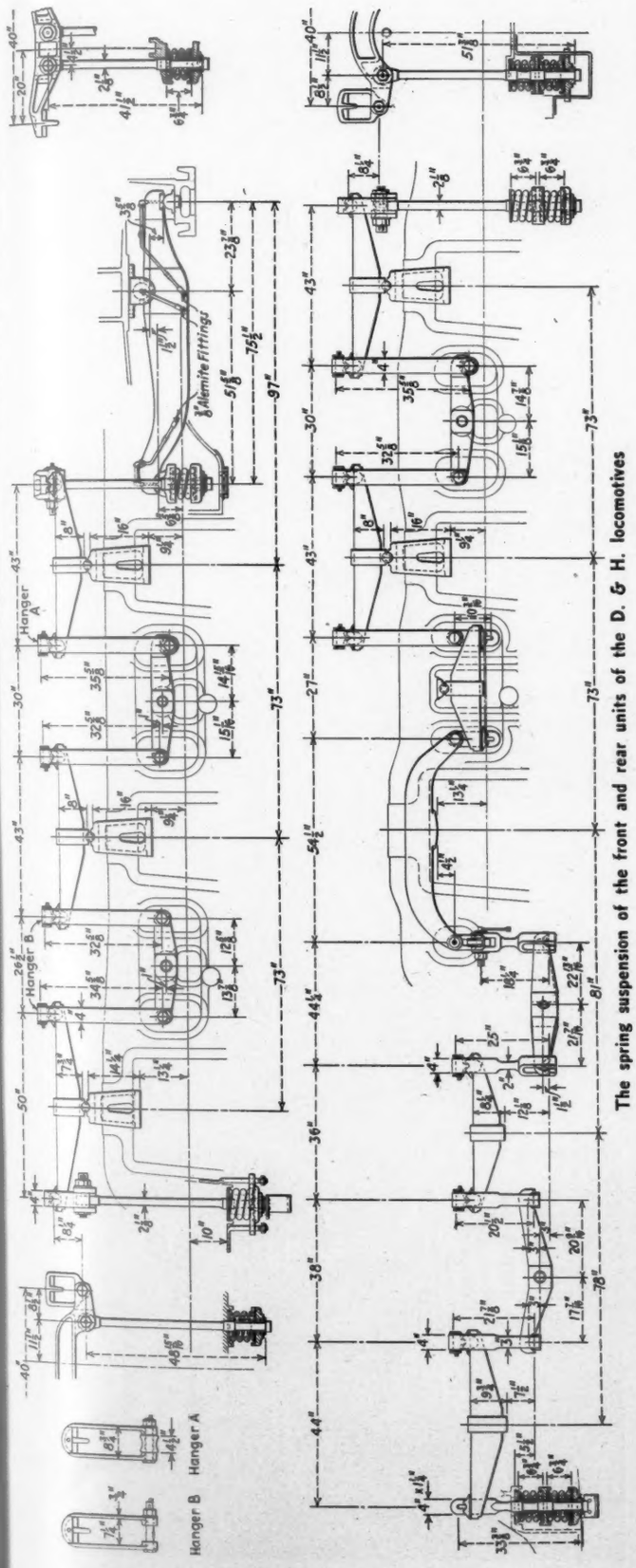
tangular water-leg type designed for 22,500 gallons of water and 26 tons of coal. The tender trucks are Gen-



The main driving wheels are fitted with SKF roller-bearing journal boxes

General Dimensions, Weights and Proportions of the D. & H. 4-6-6-4 Freight Locomotives

Railroad	D. & H.
Builder	American Locomotive Co.
Type of locomotive	4-6-6-4
Road class	J-95
Road numbers	1500-1519
Date built	1940
Service	Freight
Dimensions:	
Height to top of stack, ft.-in.	16-2
Height to top of dome, ft.-in.	16-5½
Height to center of boiler, ft.-in.	11-0
Width overall, ft.-in.	11-3⅛
Cylinder centers, in.	92
Weights in working order, lb.:	
On drivers	406,500
On front truck	76,000
On trailing truck	114,500
Total engine	597,000
Tender	389,100
Wheel bases, ft.-in.:	
Driving	12-2
Engine, total	59-11
Engine and tender, total	103-6
Wheels, diameter outside tires, in.:	
Driving	69
Front truck	36
Trailing truck:	
Front	36
Back	45
Engine:	
Cylinders, number, diameter and stroke, in.	4-20½x32
Valve gear, type	Walschaert
Valves, piston type, size in.	12
Maximum travel, in.	7½
Steam lap, in.	1¼
Exhaust clearance, in.	Line and line
Lead, in.	9/16
Boiler:	
Type	Straight top
Steam pressure, lb. per sq. in.	285
Diameter, first ring, inside, in.	94 11/16
Diameter, largest, outside, in.	102
Firebox length, in.	213 1/32
Firebox width, in.	108 9/16
Height mud ring to crown sheet, back, ft.-in.	11-0
Height mud ring to crown sheet, front, ft.-in.	7-0¾
Combustion chamber length, in.	94
Arch tubes, number and diameter, in.	5-4
Tubes, number and diameter, in.	222-2¼
Flues, number and diameter, in.	60-5½
Length over tube sheets, ft.-in.	22-0
Net gas area through tubes and flues, sq. ft.	105.9
Fuel	Bituminous coal
Stoker	Standard HT
Grate type	Firebar
Grate area, sq. ft.	108
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	556
Arch tubes	77
Firebox, total	633
Tubes and flues	4,756
Evaporative, total	5,389
Superheater	1,681
Combined evap. and superheat.	7,070
Exhaust steam injector	Elesco No. 3
Tender:	
Type	Water bottom
Water capacity, gal.	22,500
Fuel capacity, tons	26
Trucks	Six wheel
Journals, diameter and length, in.	7 x 14
Rated tractive force, engine, 85 per cent, lb.	94,400
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	68
Weight on drivers ÷ tractive force	4.31
Weight of engine ÷ evap. heat. surface	111.0
Weight of engine ÷ comb. heat. surface	84.58



The spring suspension of the front and rear units of the D. & H. locomotives

The cab interior

Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	8.95
Tube-flue heat. surface, per cent comb. heat. surface	67.27
Superheater heat. surface, per cent comb. heat. surface	23.78
Firebox heat. surface ÷ grate area	5.86
Tube-flue heat. surface ÷ grate area	44.03
Evap. heat. surface ÷ grate area	49.90
Superheater heat. surface ÷ grate area	15.57
Comb. heat. surface ÷ grate area	65.47
Net gas area, tubes-flues ÷ grate area	0.98
Tractive force ÷ grate area	874.2
Tractive force ÷ evap. heat. surface	17.52
Tractive force ÷ comb. heat. surface	13.35
Tractive force × dia. drivers ÷ comb. heat. surface	921.3

eral Steel Castings Corporation six-wheel equalized type with 7-in. by 14-in. journals, 36-in. rolled-steel wheels, Miner rocking roller type side bearings, and American Steel Foundries clasp brake. Miner type A-22-XB draft rigging is used with National Malleable couplers and A. A. R. swivel yokes. The Franklin E-2 radial buffer is fitted between the engine and tender. Barco Type 3-VX flexible joints are installed between the engine and tender on the air-brake train line, the tender-brake-cylinder connection, the stoker-engine steam line, and other flexible pipe connections.

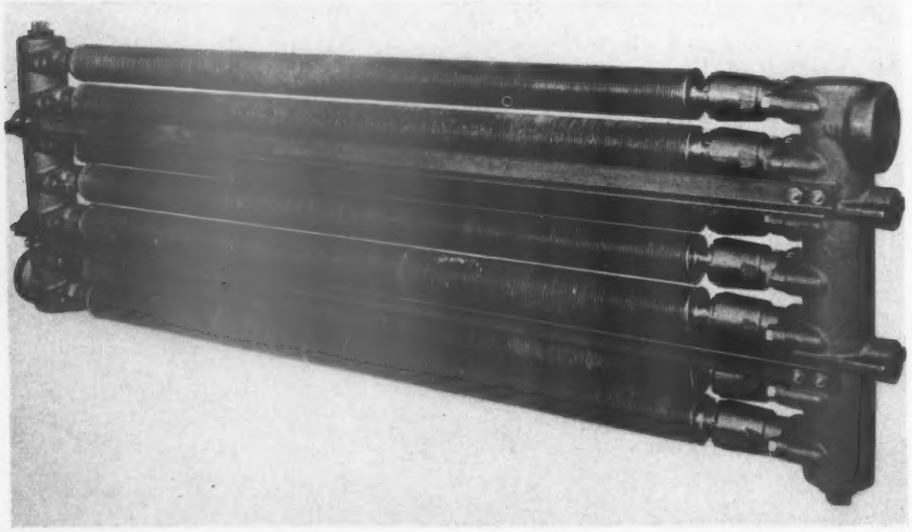
All piping extending along the boiler is concealed under the jacket, only the throttle pull rod and hand rail being visible. The sand traps are likewise placed under the jacket and the sand-box steps when not in use fold up flush with the jacket. The smokebox is also tapered $6\frac{9}{16}$ in. All of these provisions, together with the use of a top boiler check, were made to secure the best possible vision ahead for the enginemen.

The Character of the Line and Service

The line between Wilkes-Barre and Mechanicville is 215 miles long. The lines from Wilkes-Barre and Binghamton converge at Nineveh, 93 miles north of Wilkes-Barre and 24 miles north of Binghamton. Between Wilkes-Barre and Nineveh the maximum grades are 1.5 per cent. Northbound, the maximum grades between Binghamton and Mechanicville are slightly over one per cent. Southbound, they are about 1.4 per cent.

From the southern end of the Wilkes-Barre line originates a large tonnage of anthracite coal which moves north toward Canada and New England. Between Wilkes-Barre, Binghamton and Mechanicville there is a considerable movement of manifest freight which has increased greatly in volume during the past few years. The increasing necessity for maintaining schedule deliveries to connecting roads has made imperative the employment of modern motive power suitable to meet this requirement, often operating under adverse conditions.

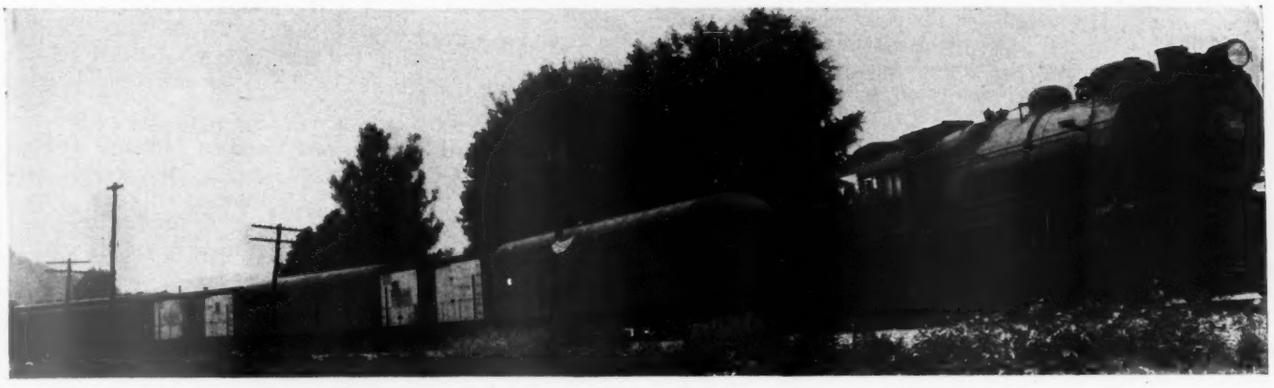
Prior to the delivery of the articulated locomotives, the D. & H. operated exclusively in this service consolidation types of much less individual power, a condition which required for the distance between terminals an unusual amount of helper service and double heading. The driving wheels of the consolidation type locomotives in this service are 57 in. and 63 in. in diameter, and counterbalance conditions for the high rotative speeds required were not all that could be desired. The adoption of this Mallet type locomotive with 69-in. driving wheels has solved many of the past operating difficulties insofar as decreasing track stresses through shorter rigid wheel base and better counterbalance conditions are concerned.



The fin tube radiator of the main reservoir air-cooling system is equivalent to more than 50 ft. of 2-in. pipe—It is 6 ft. long by 1½ ft. high

* * *

Looking north from within the big train shed at Reading terminal, Philadelphia, Pa. The "Crusader" has just arrived at the right and a multiple-unit electric train at the left is about to leave for the suburbs



Train used for A. A. R. high-speed freight car truck tests

A. A. R. High-Speed Freight Car

Truck Test Report

Most comprehensive truck tests ever conducted by the railroads —Individual trucks not rated, but report shows the advantages and the limitations of each

IN the latter part of 1938, at the request of the vice president of the Operations and Maintenance Department of the Association of American Railways, the General Committee considered the investigation of trucks for high-speed freight service and at its meeting held on November 16, 1938, "It was decided that this subject should be referred to the Committee on Car Construction with instructions to co-operate with the Committee on Brakes and Brake Equipment, the Committee on Wheels, and W. I. Cantley, mechanical engineer, in an investigation of trucks for high-speed freight service, and, if necessary, make tests covering all phases of the problem, including brakes, wheels, etc."

In accordance with the foregoing, the Committee on Car Construction appointed a subcommittee consisting of W. A. Newman, chief mechanical engineer, Canadian Pacific; J. McMullen, superintendent car department, Erie; F. A. Isaacson, engineer car construction, A. T. & S. F.; J. T. Soderberg, general foreman, Pennsylvania and T. M. Cannon, engineer car construction, C. M. St. P. & P. R. R. The purpose of the investigation was to aid in the study of the problems involved. The data secured would then be available for use in designing and building freight car trucks suitable for high speed.

The A. A. R. sub-committee met on January 11, 1939, to formulate plans for procedure. It was decided that the scope of the investigation would be: (1) To determine whether the conventional freight truck is safe to operate at high speeds—i. e. 80 m. p. h. or over and has satisfactory riding qualities at 80 m. p. h. or over; also (2) To determine riding qualities and performance of trucks designed specifically for the above high speed service.

At its first meeting the A. A. R. sub-committee decided that the method of procedure would be to conduct tests under actual service conditions by operating different trucks in a high speed train and measuring their performance. Aside from differences in design of trucks it was proposed specifically to investigate the effect of differences in track, differences in load, and differences in wheels.

On January 12, 1939, there was held a joint meeting of the A. A. R. sub-committee, representatives of the A. A. R. brake and wheel committees and representatives of the various truck manufacturers, at which time the different manufacturers were invited to furnish free of charge a car set of trucks which they had developed for high speed service or which they had in the process of development. The trucks were to be furnished for 5½-in. by 10-in. journals and have physical dimensions making them suitable for installation under the test cars. The trucks were to be furnished without wheels and axles, journal bearings and wedges, and were to be equipped with plain side bearings. They were to be assembled and tried out in service before being offered for test. Complete drawings were to be furnished, with the understanding that if in the opinion of the subcommittee the trucks were unsafe for high speed operation they would be rejected for test. The manufacturers were advised that only one design of truck could be entered by one manufacturer, and that the truck sides and bolsters were to meet the A. A. R. specifications for strength. Ten different truck manufacturers had representatives present at this meeting and they all indicated that they wished to co-operate to the fullest extent in this investigation.

The sub-committee at first proposed to use both rolled steel and cast iron wheels in testing these trucks. It was contemplated testing the trucks with each kind of wheel, first, in the as-rolled or cast condition which comes within the A. A. R. tolerances, and second, with the wheels ground so that treads were truly round and concentric with the journals. It was also contemplated making some tests with wheels that had developed hollow treads from wear in service. Further consideration of the subject resulted in a decision to test only with concentric wheels and eccentric wheels, both of which had been ground so as to be truly round, and use only

steel wheels. It was felt that the round concentric wheels would represent the best wheel condition to be encountered in service and the round eccentric wheels would represent a bad wheel condition which would be the same for all trucks tested.

In order to investigate the influence of differences in track the sub-committee realized that it would be advisable to select a test site that would have different kinds of track over which the test train could be operated. The test site finally selected included both main line passenger track which was probably in as good condition as any track in the country and also branch line track which was good sturdy track but which did not have the maintenance that the main line track had.

The question of loads was decided from consideration of the empty weight of the test cars and the capacity of the trucks tested. After all the instruments were installed in the cars it was found that the lowest rail weight that could be obtained was 58,000 lb. For the heaviest load the customary limit of 85 per cent of axle limit load for express service was adopted, which gave the highest rail weight as 145,000 lb.

The final test program decided upon was as follows: Each truck to be given one round trip with concentric wheels and loads of 58,000 lb., 83,000 lb., 113,000 lb., and 145,000 lb. rail weight. Each truck was then to be given one round trip with eccentric wheels and the same loads.

Classification System for Trucks Entered in A. A. R. High-Speed Freight Truck Tests

A. = Integral Journal Box Trucks—side frame is unsprung weight
- I = Designs with springs located in an opening at the center of the side frame
  - 1—A. A. R.
  - 2—A. S. F.
  - 3—National
  - 4—Ohio
  - 5—Railway
- II = Design with springs located at various positions
  - a. = Spring groups in parallel
    - 1—Buckeye
    - 2—Simplex
  - b. = Spring groups in series
    - 1—P. R. R. No. 1
    - 2—Scullin

B. = Separate Journal Box Trucks—side frame is sprung weight
- 1—Barber
- 2—Full Cushion
- 3—Symington

The sub-committee reserved the right to discontinue tests on any truck if at any time it appeared to be unsafe for operation at these high speeds.

The 12 trucks tested and the sponsor of each were as follows: (1) A. A. R. Truck—the conventional design of spring plank truck, equipped with 1936 plain coil springs. These trucks were secured from the stock of the Pennsylvania. (2) A. S. F. truck—furnished by the American Steel Foundries, (3) Barber truck—furnished by the Standard Car Truck Company, (4) Buckeye truck—furnished by the Buckeye Steel Castings Company, (5) Full-Cushion truck—furnished by the Allied Railway Equipment Company, (6) National truck—furnished by the National Malleable & Steel Castings Company, (7) Ohio truck—furnished by the Ohio Steel Foundries, (8) PRR No. 1 truck—furnished by the Pennsylvania, (9) Railway truck—furnished by the Railway Truck Corporation, (10) Scullin truck—furnished by the Scullin Steel Company, (11) Simplex truck—furnished by the Bettendorf Company, (12) Symington truck—furnished by the Symington-Gould Corporation.

(Each one of these trucks was described in detail on the report with photographs, drawings, spring group characteristics and a list of parts with weights. Following the descriptive section there was a classification system for the various trucks, based mainly on the arrangement of the springs in the truck and considered helpful in evaluating the relative worth of the different designs. —EDITOR)

Location and Equipment Used in Making Tests

These tests were made on the Pennsylvania between Altoona, Pa. and Lock Haven. From Altoona to Tyrone, a distance of 14.2 miles, is main line track; from Tyrone to Lock Haven, a distance of 54 miles, is branch line track that is maintained for heavy freight service and branch line passenger trains. Headquarters for the tests were located at the Altoona Car Shops of the Pennsylvania, where the work of building and installing the trucks was performed. A day's test consisted of a trip from Altoona to Lock Haven and return. Practically all of this track is laid with new 130 and 131-lb. rail in 39-ft. lengths, there being only a very short stretch in each track laid with cropped rail. It is rock ballasted all the way and is maintained in first class condition. Battered joints are periodically built up by welding and the surface of the rail is ground at intervals to remove any corrugation that may have developed. The curves are super-elevated, and regular passenger trains are given a 70 m.p.h. speed limit on this track with a restriction to 15 m.p.h. from Grazier eastward to beyond Tyrone. The test train was given a speed limit of 85 m.p.h. on the stretch from Altoona to Grazier. Most of the test runs started and stopped at RO Tower, but on account of operating conditions it was necessary to start a few runs from the passenger station. The test train left the eastbound passenger main at milepost 223.4 to cross over to the branch, and it arrived back on the westbound passenger main from the branch at milepost 129.7, which gave a little more than a half mile running in this stretch that was not on the passenger mains and was done under a restriction of 15 m.p.h.

The Bald Eagle branch, extending from Tyrone to Lock Haven, is a single track line with passing sidings operated under controlled manual block system. Mileposts are numbered from Tyrone. The rail is all relaid 130-lb. section, some being 39-ft. lengths and some being cropped rail. It is rock ballasted throughout and is good track, but it does not receive the maintenance that the main line track receives. The curves are not super-elevated. Regular passenger trains are given a speed limit of 60 m.p.h. on this branch. Before these tests were started the track was given special attention so as to make it safe for the test train to attain a speed of 85 m.p.h. over certain stretches.

Regular stops for inspection of equipment were scheduled at Tyrone and Milesburg in each direction and at Lock Haven for turning the locomotive on the wye and putting it on the other end of the train. The test train was given a regular schedule which was adhered to as closely as operating conditions would permit. The train was operated on a clear block throughout the entire distance in order to permit making the same speed schedule on each run. On the main line operation was controlled by automatic block system. On the branch line it was controlled by manual block system with operators located at Park, Port Matilda, Milesburg, Wood and Lock Haven. In September traffic on the branch line increased to such an extent that operators were stationed at Eagle and Hall towers; at first intermittently and later regularly. Hand signals were used to control operation from these two towers.

A normal speed chart for both directions of running is shown in this report. For convenience the profile and speed diagrams are given on the same page for the same stretch of track. The goal for operation of the test train

was to duplicate speed as closely as possible on successive runs and to do as much running as possible at speeds above 60 m.p.h. The problems encountered in the operation of freight cars at speeds up to 60 m.p.h. are pretty generally understood as a result of tests conducted by the Association of American Railroads in 1933, and methods of solving these problems are known. In order to do any substantial amount of running at high speeds, it was necessary to attain those high speeds as quickly as possible after starting. The desired speed schedule over each stretch of track was made as high as curves and grades would permit, the theory being that if a truck performed satisfactorily at the highest speeds it would perform satisfactorily at lower speeds. It was known that some freight trucks exhibit critical speeds below 60 m.p.h. and it was suspected that critical speeds above 60 m.p.h. might be found. One of the jobs of the observers riding the test cars was to watch for the exhibition of these critical speeds.

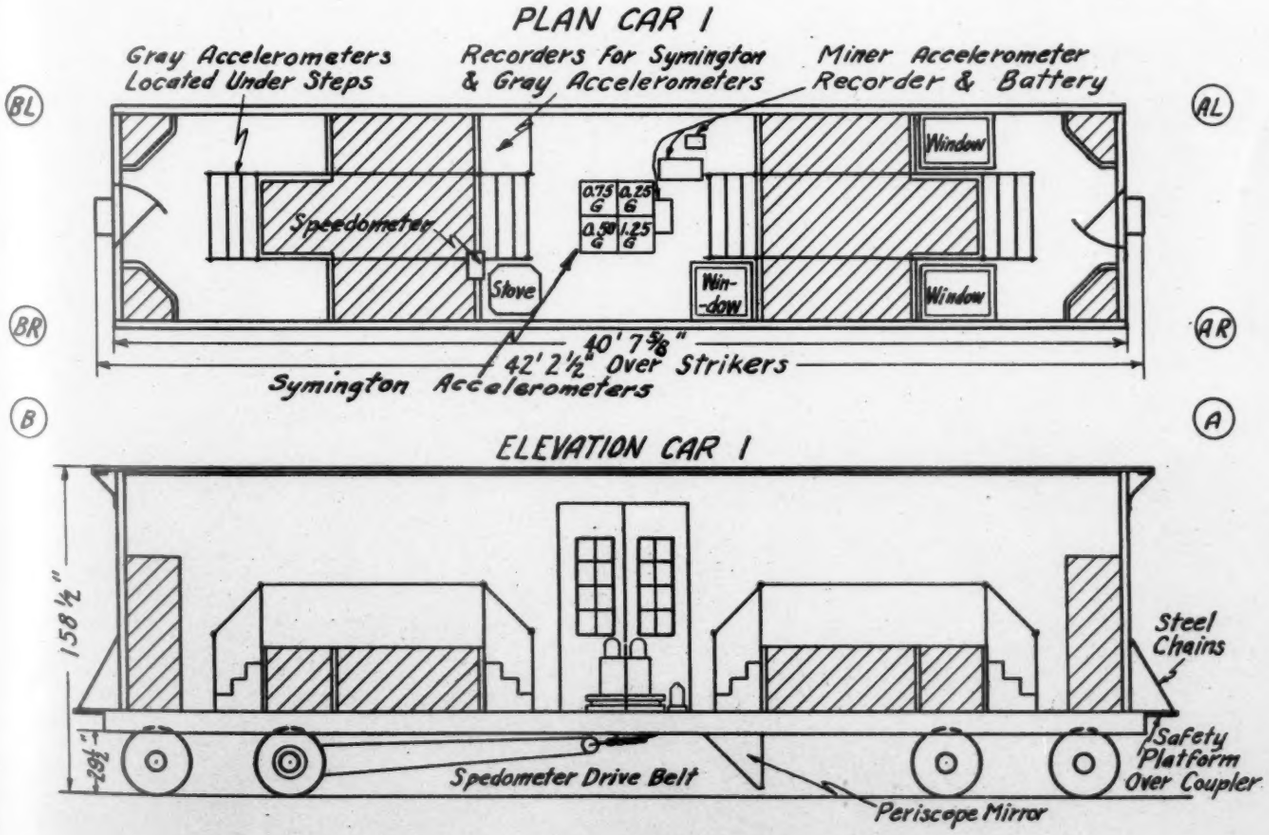
The first test run was made on June 1, 1939, this being a preliminary run to try out the set-up. Several more preliminary runs were made and the regular program was started on June 16, 1939. Throughout the first series of runs, which included every truck at the light load, runs were made every other day in order to give each manufacturer an opportunity to approve the assembly of his trucks. The test train was operated with extra crews during this period but the road foreman of engines or his assistant rode the engine and controlled operation. On July 17, 1939, a regular crew was assigned to the train and from then on runs were made on every week day except when load was being changed, and the same engineman handled the throttle on all runs. The regular program of tests was completed on October 20, 1939.

The Test Train

One illustration shows the test train at one of its stops on an eastbound run. The consist is locomotive, baggage car, test car No. 1 which carried the base truck used as a measuring stick, baggage car, test car No. 2 which carried the truck being tested, and passenger coach; a total of a locomotive and five cars.

The locomotive was Pennsylvania No. 3002, an Atlantic type, designated as E-6-s by the Pennsylvania. The wheel arrangement is 4-4-2, the drivers being nominally 80-in. in diameter. The rated tractive force is 31,275 lb. This is a fast locomotive which is used for light passenger service. It was hand fired. It had been given classified repairs just before the start of these tests and was assigned to the test train when it came out of the shop. It was used for every test run made. A Weston speedometer was installed to guide the engineman in running. The magneto was mounted on the right side of the pilot and driven by a spring belt from a wooden grooved pulley attached to the right front pilot wheel. The speedometer indicator was placed in the cab in front of the engineman's position.

The baggage cars and coach were carried to place the test cars between cars which would remain unchanged throughout the progress of the test and therefore always subject them to the same influence of the coupled car. They also served to bring the braking power of the train within requirements for passenger train operation, as the freight cars were low in braking power when heavily loaded. The passenger cars were braked to 90 per cent of their light weight and the freight cars to 73 per cent of their stenciled light weight of 46,400 lb., with 50-lb. brake cylinder pressure in both cases. This high figure for the freight cars was attained by changing the body levers as much as possible to stay within the



Schematic drawing showing arrangement of one of the test cars

strength of the brake beams when getting a passenger emergency application. The coach also served as headquarters for the train crew. All three of the passenger cars were equipped with four wheel passenger trucks having 5½-in. by 10-in. journals and steel wheels. The baggage cars were Pennsylvania standard 60-ft. cars, light weight 101,000 lb. The coach was 70 ft. long, light weight 130,000 lb. The front baggage car was used to charge the spare storage batteries used in operating the test instruments. A connection was taken off the regular car batteries for this purpose, the regular generator on the car furnishing current to keep the car batteries charged.

The middle baggage car was fitted up as an office and work car. Facilities were provided for repairing and calibrating instruments, as well as performing the paper work in connection with the tests. This car also gave storage space for some of the smaller pieces of equipment and tools, etc., used in connection with the tests. During the last part of the runs with eccentric wheels the recorders for the Gray accelerometers were located in this car. After the weather became cold it was equipped with a coal-burning stove. Instrument cables from Test Car 2 to Test Car 1 passed through the middle baggage car, holes being cut in each end for this purpose. These cables were provided with connectors for parting when it became necessary to break up the train to work on the test cars.

The two test cars were from a lot of several hundred 50-ton cars originally built for the Delaware, Lackawanna and Western. Car No. 1 was built in March, 1928 and Car No. 2 was built in August, 1927. These cars have steel underframe, superstructure and ends, with wood siding.

In order to fit them for test purposes they were provided with doors in each end for passage between the cars. The regular steel side doors were blocked in open or partly-open position and glazed wooden doors installed to facilitate entrance and exit. Extra steps and grab irons were provided at the side doors. Observation windows about 12 in. square were placed in the sides of the cars. These were accessible from seats inside the car and were fitted with angular mirrors to afford a view along the side of the train in both directions while running. The interiors of the cars were fitted with lading bins to confine the lading and leave free floor space for instruments and observers. Three windows were placed in the floor of each car to afford a view of the trucks while running. Two of these windows were located in one end of the car and the third was located near the center. The end windows were on each side over the inside wheels of the truck where they afforded a view directly down on the truck. The center window was located to the side of the car and was equipped with a mirror placed on an angle underneath the car floor so as to give a view looking at the inside of the truck. One of the drawings shows in plan and elevation the arrangement of the various features of test car No. 1. Both test cars were equipped with air signal lines, signal valves, emergency brake valves and passenger triple valves to make them acceptable for operation in passenger service.

The corner lading bins were constructed from ¼-in. thick steel plate bolted into place on angle irons, and were provided with a removable hatch to facilitate loading. The framework for the main lading bins was made of angle iron bolted to the car floor and sides, and the steel partition sheets were bolted to this framework. The tops of these bins were covered with removable planking to provide a central passageway through the cars, this passageway being guarded by a hand rail. Steps were provided at each end of the passageway to reach the level of the tops of the lading bins. An interior view of each car is shown in Figs. 40 and 41.

The stenciled light weight of Car No. 1 was 47,900 lb. and for Car No. 2 it was 46,400 lb. After all the instruments were installed and Car No. 1 was equipped with the PRR No. 1 truck and Car No. 2 with the AAR truck, the cars were weighed. It was found that Car No. 1 weighed 57,360 lb. and Car No. 2 weighed 53,360 lb., the increase over the stenciled light weight coming from the addition of lading bins, instruments, etc. Sufficient lead was put in the corner lading bins of each car to bring the weight to 58,000 lb. which was then used as the lightest test weight. In running tests no attention was paid to the variation in weight of the different trucks installed on Car No. 2.

Wheels

New wheels were used throughout for these tests, secured from the stock of the Pennsylvania. They were 33-in. one-wear steel wheels with reinforced flange and 1¼-in. rim. After mounting on the axles the treads were ground to give the desired contour and concentricity and to get the same tape size on both wheels of a pair. The taper used on the tread was the A. A. R. standard of 1 in 20.

For preparing the eccentric wheels a recessed cap was fastened on each end of the axle, these caps having centers $\frac{3}{64}$-in. eccentric with the bore of the cap where it fitted the axle end. They were fastened to the axle with cap screws tapped into the ends of the axle, care being used to locate the caps so that the high points on the two ends of the axle would match. The axle wheel seat was machined with the axle carried on the two cap centers, this resulting in the wheel seats being $\frac{3}{64}$-in. off center with the journals which were machined with the axle mounted on its own centers. The wheels were then mounted on the axle and the treads were ground with the axle mounted on the cap centers. The tapped holes in the axle ends were filled with lead after the machine work was done.

In order to facilitate changing trucks under Car No. 2 three sets of concentric wheels and three sets of eccentric wheels were prepared. This gave one set to use under Car No. 1 and the other two sets were used alternately under Car No. 2, one set being installed on the trucks for the next day's run while the other set was being used for a run. The wheels were marked so as to be always installed in the same position under the car, and each make of truck was always equipped with the same set of wheels every time it was assembled. Six sets of journal bearings were provided, and these were marked so that they could always be applied to the same journal. Care was used in handling the wheels so as not to nick the treads or journals, and in operating the train so as not to produce slid flat spots.

Instruments

Most of the performance of the different trucks was determined by measuring the shocks they delivered to the body of the car while in motion. These measurements were supplemented by the observations of men riding the cars to watch the action of the car and trucks while in motion, and who inspected the trucks at each stop.

Car No. 1 was equipped with a Valve Pilot speedometer which indicated speed and also drew a speed chart of the run. This speedometer was driven from the No. 2 axle of the car by means of a long rubber V belt passing over a split pulley mounted on the axle and over the speedometer drive pulley which was located under the car floor. This drive pulley was mounted on a pivoted arm to which was attached an extension coil

spring to maintain tension on the drive belt. The drive pulley was connected to the speedometer registering mechanism located inside the car by means of a flexible shaft running inside rigid metal conduit.

In order to determine if any springs went solid lead wires were applied at the points which would touch, wherever this was possible. Lead wire $\frac{1}{16}$-in. in diameter was used for this purpose. In some cases where it was impossible to use this wire the surfaces which would touch were painted with a rather heavy coat of quick drying paint. In other cases the trucks were fitted with push gages which would indicate the maximum motion of the parts during the preceding stretch of running. These devices were examined at each stop for indications or records of springs going solid.

The shocks delivered to the car body were measured by accelerometers attached to the car body. Three different designs of these instruments were used in order to secure as much data as possible. All three of these designs used the same principle of operation, in that each had a series of guided weights of uniform mass, each held against a stop by a spring, the pressure of which could be nicely graduated. Whenever a weight was subjected to a shock which was heavy enough to overcome the pressure of the spring holding it against the stop the weight would move away from the stop until the shock had passed, when it would return to its position against the stop. Some form of electrical indicating or recording means was provided to show the number of times each weight moved away from its stop during a run. By setting the pressure of the spring to a different value for each weight in the instrument the shocks occurring could be separated out into any desired range of values. This form of accelerometer is known as a "Contact Accelerometer." It is wholly free of errors caused by the weight spring getting into resonance with the shocks which occur because its indications are taken from the fact that the weight moves away from the stop and not from the distance it moves. Each weight can respond only to shocks which are heavy enough to overcome the pressure of its spring, and whenever such shocks are not present the weight is held in its neutral position against its stop.

(At this point the report included a description and illustrations of the Miner, Symington and Gray Accelerometers, the three different designs which were used in the tests.—EDITOR.)

Method of Conducting Tests

By nature, this was a competitive test. Any manufacturer who had a car set of trucks which he thought was satisfactory for high speed service was privileged to enter them, subject only to the opinion of the subcommittee as to the safety of the trucks and the requirements that the parts should meet the A. A. R. specifications for strength, and that the trucks should have been previously assembled and operated in service. It was, therefore, necessary to keep the conditions as nearly as possible constant throughout the test in order to guard against favoring one truck or penalzing another.

The use of a special train with clear block signals gave a good measure of control over the speed at which the train would operate, but there were variables in the weather and in the condition of the track from day to day caused by maintenance. It was also realized that small differences in speed from day to day might have an appreciable effect on the performance of a truck so it was decided that the only fair way to test would be to use one of the trucks as a base truck and test all the other trucks against it. One test car would be equipped with the base truck and the other car would be equipped with the rest of the trucks in turn, with the loading, wheels, instruments, etc. in the two cars as nearly alike as it was possible to make them. The PRR No. 1 truck was selected as the base truck because it had been tried out in high speed service and also because it was not sponsored by a manufacturer of trucks. The A. A. R. truck was not selected as the base truck since it could not be expected to perform satisfactorily at speeds of 80 m.p.h. or over.

The location of the different accelerometers in one of the test cars is shown in a drawing. The Symington accelerometer weight units were located in the center of each car, being mounted on a cast steel base plate which was large enough to accommodate four units. This base plate was fastened to the car floor with lag screws and the weight units were bolted to the plate. The size of these weight units makes them practically non-portable, and the position of the individual units was not changed during the test. Their calibration was checked at frequent intervals between runs, and always whenever there was reason to suspect that it might have changed. Very little trouble was experienced with the spring pressure getting out of calibration but there was considerable difficulty in keeping the switches adjusted to give the proper weight travel before the switch opened. The counters and batteries for all of the Symington accelerometers were located in Car No. 1.

The Miner accelerometer weight units were located near the center of each car. A base plate made of $1\frac{1}{2}$-in. thick boiler steel was fastened to the floor with lag screws in a position next to the Symington base plates and centered laterally. The Miner instruments were bolted to this base plate, with the weight guide arms extending crossways of the car. The recorder and battery for each instrument were located close to the weight unit. The Miner weight units and recorders were interchanged between test cars at Lock Haven each day in

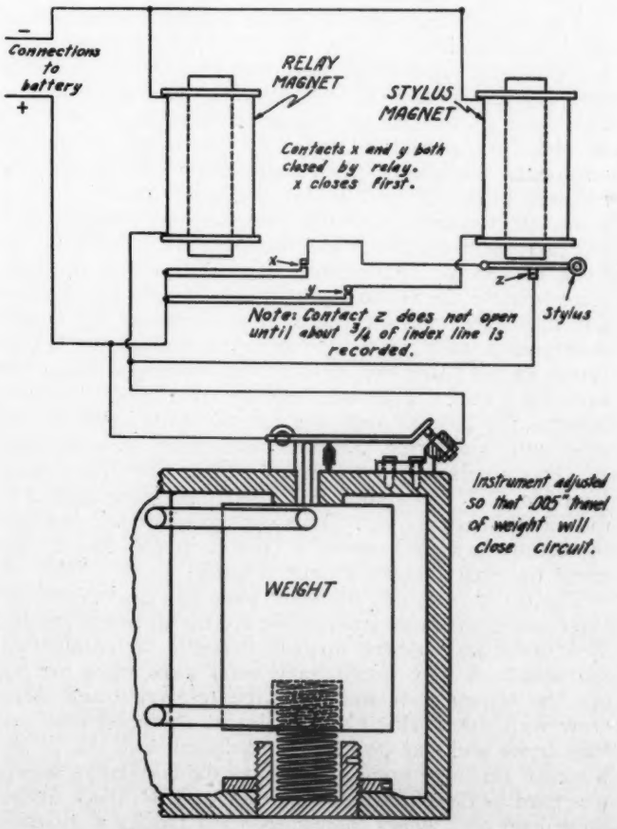


Diagram of Miner accelerometer

order to eliminate the effect of any possible difference in the instruments. These instruments were calibrated at frequent intervals between runs, and always when-

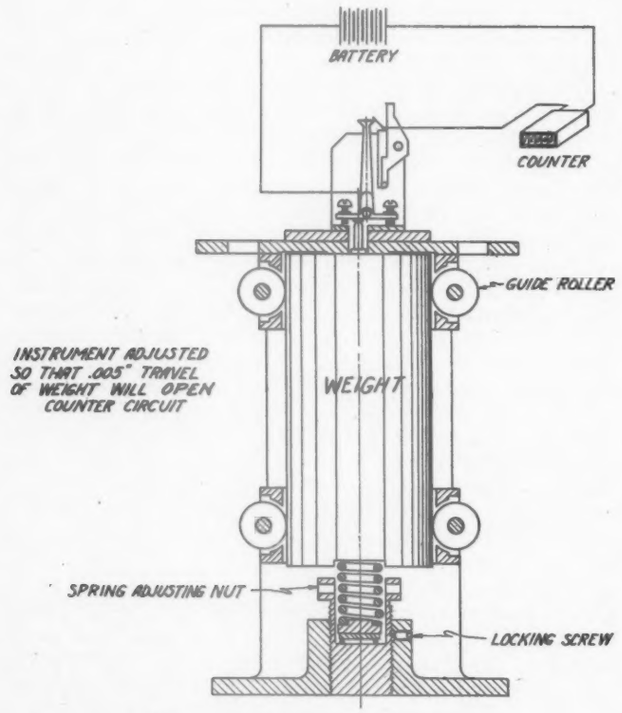


Diagram of Symington accelerometer

ever there was reason to suspect that they might have changed calibration.

The Gray accelerometers were located in the end of each car directly over the bolster. A base plate made from 1½-in. thick boiler steel was fastened to the floor with lag screws and the instrument cases were bolted to this plate. One vertical instrument and one lateral instrument were used in each car, this being all the instruments available. Their calibration was checked at frequent intervals, just as for the other accelerometers. These instruments were not interchanged between cars regularly as were the Miner instruments. Each day at Lock Haven the instruments were reversed on the base plate because the vertical instruments should be installed with the weight pivots leading, and reversing the lateral instruments gave an opportunity to investigate lateral forces in the direction opposite that investigated on the eastbound trip. This was merely an attempt to compensate for lack of sufficient lateral instruments. The tube units, batteries, counters and chart recorders for all Gray accelerometers were located in Car No. 1 until Run No. 118 was completed, when they were moved to the middle baggage car. This change was made because the eccentric wheels caused a chatter in Car No. 1 that made the chart record almost illegible.

The order in which the tests were run also served to keep conditions more comparable for the different trucks. This order was decided upon to expedite the conduct of the tests. A few preliminary runs were made to try out the set-up and familiarize the test crew and train crew with the work. Car No. 1 was equipped with the base truck and Car No. 2 was equipped with the A. A. R. truck for these preliminary runs, the last one of which was used as the official run for the A. A. R. truck under these load and wheel conditions. All trucks were then tested under these same conditions, since it involved less time and expense to change trucks than it did to change load. This arrangement had the advantage of testing the different trucks under more nearly comparable conditions of weather and track and skill of train and test crews. During the first series of tests with concentric wheels and 58,000 lb. rail weight a test run was made every other working day, the intervening days affording an opportunity to assemble the truck for the next run under the supervision of a representative of the manufacturer and also to go over the instruments thoroughly. Track maintenance on the branch was increased during this time in accordance with the reports of the crew of the test train, so that a high speed schedule could be attained on the branch. The engine and train crews were from the extra list, but all of the running was done by the road foreman of engines or his assistant. Beginning with the second series of tests, in which the load was increased to 83,000 lb. rail weight, a regular train crew was assigned and all running after that was done by one engineman.

Shop Work

While the test train was making a run a crew of shop men would build the trucks for the next day's run, using the wheels from the trucks tested the previous day. The same crew was always used for this work to insure proper assembly of the trucks. Upon arrival at the shop, test Car No. 2 would be placed on a track having overhead crane facilities for changing trucks. After installation of the next trucks the side bearing clearance was set to ⅛-in. per side and the brake cylinder piston travel was checked to see that it came within limits of 7 to 7½-in. The journal boxes were then packed, using new passenger type packing each time. A liberal coating of oil had been applied to the journal bearings when they were installed. The test train was then made up for the next day's run. The trucks removed were torn down the same afternoon in order to inspect them for

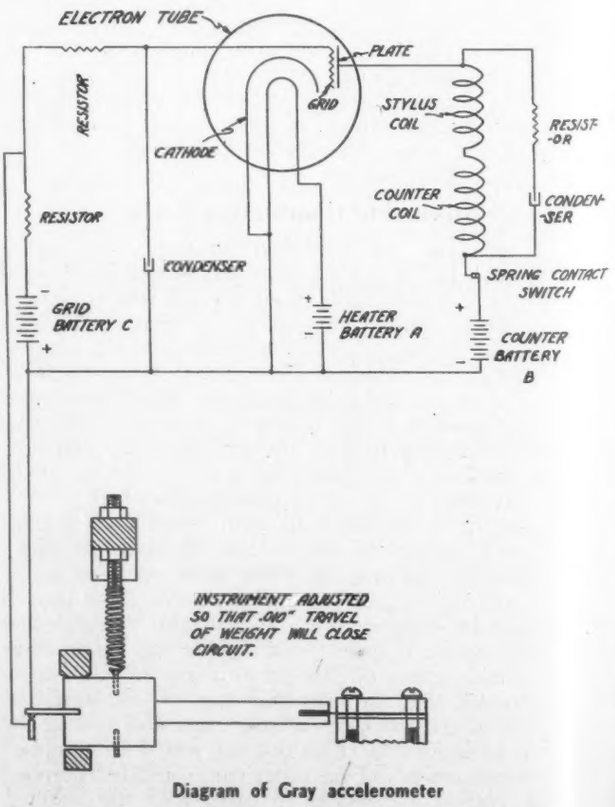


Diagram of Gray accelerometer

possible necessary repairs before using the parts or wheels again.

For loading the cars, lead pigs weighing about 35-lb. each were used. These had the advantage of being easily handled, although it took considerable time to handle enough of them to make the required change in load. They occupied small space for a given weight, thus not interfering with space required for instruments and observers. They gave a lower center of gravity than would be obtained with most commercial loads, which fact would probably make the car bodies more stable from the standpoint of rocking. The load was arranged the same way in both cars and an effort was made to keep the distribution as nearly uniform over the floor surface as possible.

(At this point the report included an explanation of the test data secured and an interpretation of these data, followed by 84 pages of detail performance data for the various types of trucks tested.—EDITOR.)

Discussion of Results

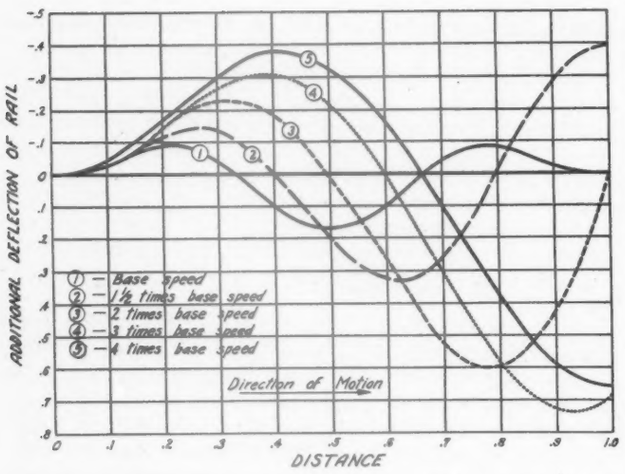
It has been known for a number of years that freight cars equipped with plain coil springs have critical speeds —i. e. certain speeds at which they ride worse than they do at either lower or higher speeds. The fundamental cause of this action is resonance. Some disturbance is received by the car which is periodic, meaning received at regularly repeated intervals. If the period of these disturbances coincides with the period at which the springs will naturally oscillate the conditions for resonance exist and a large amplitude of oscillation of the springs will be built up and a rough ride will follow. No one of the disturbances by itself would have much effect in giving a rough ride, but a number of these small disturbances repeated at regular intervals can result in a very rough ride. Freight cars are subjected to two pronounced periodic effects as they move along the track. The first of these comes from the wheels, as every complete revolution of a wheel causes a repetition of any variation in effect it may have as it revolves. Eccentricity and flat spots are the worst offenders encountered. The second periodic effect comes from the rail joints because rail lengths are substantially uniform and the distance between joints is covered in equal intervals of time at uniform speed. The speed at which resonance will occur depends upon the time of natural vibration of the springs, and this is determined by the deflection of the springs under the load they are carrying. It will thus be seen that the critical speed or speeds for any car will depend upon the load it is carrying at the time.

It so happens that the critical speed of average freight cars so far as wheel action is concerned is somewhere around 25 m.p.h. It is rather narrow in range, sometimes being only about two m.p.h. wide. Its location and narrow range make it unimportant from an operating standpoint, but this statement does not mean that it can be ignored. The critical speed from rail joints is somewhat higher than from wheels, and is wider in its range. It may be as wide as 10 m.p.h., and seems to occur at speeds between 40 and 50 m.p.h. Because of its width its effect may be felt at speeds from 35 m.p.h. up to 55 m.p.h., depending upon the load in the car, and sometimes at even higher speeds. Stiff springs and light loads cause it to occur at higher speeds. The effect that this critical action produces on the car body depends upon the amplitude of spring oscillation which is built up. If this is large a heavy shock may be produced by each bounce. The amplitude of oscillation will build up until it is sufficient to absorb the energy delivered to the car body by the wheel or rail joint disturbance. Fortunately, it can be reduced by using springs which have a higher energy-absorbing rate than plain coil springs. There are a number of designs of friction springs or snubbers that have proved adaptable for this purpose. Every truck in this test, with the exception of the A. A. R. truck, had some device incorporated in the spring suspension to raise the energy absorption rate to take care of this critical action. There is doubtless some minimum energy absorption rate which will satisfactorily control this action, and experience points to a figure of about twenty per cent absorption. It should be mentioned that if the absorption means unduly increase the stiffness of the spring system more harm than good may be done.

It has been thought that there may be other critical speeds higher than those mentioned above, or in other words that freight cars would exhibit this action of critical speeds in the ranges above 60 m.p.h. There is no periodic action except that of wheels and rail joints to cause the occurrence of critical speeds, and the maximum effect from both of these causes occurs at speeds below 60 m.p.h. Shocks occur at speeds above 60 m.p.h., and they may be severe if the truck is not suited for these speeds, but they are caused by the dynamic effect of individual low spots in the track rather than by the cumulative effect of a number of small disturbances repeated at regular intervals. The cars were especially watched for critical speeds by the observers who rode them, and the charts from the Miner and Gray instruments were thoroughly examined for indications of them in assembling the information given in the report under the "Detail of Observations." The only indication of anything critical at speeds above 60 m.p.h. was the high frequency vibration of Car No. 1 and the fact that some trucks seemed to ride better at 80 m.p.h. than they did at lower speeds. While this high frequency vibration might be considered critical in the sense that it seemed to be associated with a definite speed, yet it was not the same kind of action that is generally thought of when referring to critical action of freight cars. The fact that some trucks seemed to ride better after passing speeds in the neighborhood of 75 m.p.h. may be said to demonstrate the existence of non-critical speeds, which implies the existence of critical speeds. This action, however, can be explained from an effect different from periodic disturbances.

It is well known that track differs in its smoothness, this being essentially a function of maintenance. It is not the smoothness that is apparent to the eye when looking at the track that is so important, as it is the different change in surface at the different points of the rail as a train passes over it. All track must yield some under the wheel loads, and the most perfect track is the one which yields uniformly throughout its length. If it were possible to secure track like that there would be no need for springs on a freight car, because the vertical position of the car would not change as it rolled along. The impossibility of securing that kind of track dictates the use of springs to modify the shocks that result from track irregularities causing change in the vertical position of the car body. A mathematical analysis of the action of track and springs under moving cars is too complicated to be entered into a report such as this, but it can be stated that it shows that there is one speed where the effect of a low spot in the track is maximum, higher speeds producing less disturbance in the track and consequently less disturbance in the car body.

A simple illustration of this is given in the chart of curves showing the dynamic effect of low spots on rail, which has been taken from page 336 of Timoshenko and Lessells' text book "Applied Elasticity." Their nomenclature has been changed to make the illustration of the point clearer. The text book authors derive these curves


ADDITIONAL DEFLECTION OF RAIL
DISTANCE
① — Base speed
② — 1½ times base speed
③ — 2 times base speed
④ — 3 times base speed
⑤ — 4 times base speed
Direction of Motion

Curves showing dynamic effect of low spots (Timoshenko-Lessells)

in connection with the solution of the problem of stresses produced in track by the effect of low spots. They have simplified the problem in its presentation and point out certain cautions in connection with its application, but these do not detract from the value of the curves to illustrate the point that speed alone has a variable effect on the disturbance resulting from any track irregularity. No specific values are given on the curves shown here because they are intended to illustrate only a broad principle and are not to be applied to specific cases. In the chart, horizontal distances represent position along the track, the left hand edge of the graph corresponding to the start of a low spot, and vertical distances represent the additional deflection of the rail produced by the effect of the low spot, these being negative above the base line and positive below it. This additional deflection is in addition to that produced by the static action of the wheel load. Each curve gives the additional deflection produced at different points along the rail at one condition of speed. To distinguish these curves from each other they have been numbered from 1 to 5. Curve 1 represents any particular speed, curve 2 a speed at 1½ times as great, curve 3 twice as great, curve 4 three times as great and curve 5 four times as great. In the words of the authors "It should be noted that at the instant the wheel reaches the edge of the low spot the pressure on the rail and the deflection begin to diminish while the wheel begins to accelerate in a downward direction. Then, the retardation of this movement begins and with it the increase in pressure and deflection, as seen from the figure." This variation in rail deflection, and with it the pressure, is what produces the shock to the car body. It can be seen from the curves that the effect is less at higher speeds than it is at some lower speed, curve No. 4 showing the maximum positive additional track deflection and rail pressure, which occurs at a point reading about .92 on the track position scale. The popular expression puts it quite tritely which says if you run fast enough you jump over the low spots in the track.

Summary of Results

It is evident that the majority of the trucks were entered in this test more on faith in their performance at high speed than on actual knowledge of it. No particular criticism can be attached to this because there was not a great amount of knowledge of the condition encountered in high speed service prior to the running of these tests. It should be remembered that failure of any of these trucks to perform satisfactorily at speeds as high as 85 m.p.h. does not condemn them for service at lower speeds. The dividing line seems to be about 60 m.p.h.

One of the outstanding facts developed in these tests is that snubbers which have proved to be the solution of the problem of controlling oscillation at speeds below 60 m.p.h. are of little, if any, value at speeds above 60 m.p.h. The reason is easy to understand. The oscillation that occurs at speeds below 60 m.p.h. builds up from small impulses regularly repeated, while the troubles experienced at speeds above 60 m.p.h. come from individual track irregularities each one of which produces a very damaging shock unless the spring system is capable of modifying it. The usual snubber is something which is placed under the truck bolster to absorb energy during movement of the spring group. Its very presence in the spring system makes the springs more sluggish in their operation and this is the last thing desired in high speed trucks. Spring systems for high speed trucks must be lively and capable of making the wheels follow the rails with as little variation as possible in the wheel pressure on the rail. After passing over a track irregularity they must quickly return to their neutral position so as not to be in an unfavorable position when the next irregularity is reached. There must be a certain amount of absorption in the spring system to damp motion quickly and to take care of the periodic impulses encountered at lower speeds, but the degree and character of this absorption must be kept within much narrower limits for high speed trucks than for low speed trucks. The first action of a spring system in passing over a low spot at high speed is to open rather than to close, and any interference with this action is detrimental.

These tests show that softer springs are the real solution of the high speed truck problem, and the softer they are the better the results secured. The limitations in coupler height variation and the large variation between empty and fully loaded weights of freight cars place limitations on the maximum spring travel which can be incorporated in freight trucks, but very few of the trucks in this test took full benefit of the spring travel which could be used. Another difficulty exists in the use of long travel springs in compression, and that is the fact that lateral stability decreases with increased travel. Failure to provide for this in truck design may result in insufficient horizontal stability.

This question of proper horizontal stability is very important from the standpoint of safety of operation at high speed. The lateral action of the wheels is pronounced at high speed and this results in an unsquaring force on the truck. If the truck does not offer sufficient resistance to this unsquaring action it might become great enough to cause derailment. Failure to control it properly results in bad lateral shocks to the car body even if it does not approach the derailing point, and this is cause for unsatisfactory performance.

(The report included highly important supplementary information in the form of Appendix I, covering tests with resilient side bearings; Appendix II, additional modified truck tests; and Appendix III, measurements of rail stresses during the high-speed freight truck tests. —EDITOR.)

INCREASED RAILROAD SHIPMENTS.—More rail shipments of Nova Scotia coal to Central Canada may be in the offing, according to a recent statement by the Dominion Coal Administrator. It is pointed out that because of the war, coal-carrying ships available for the transportation of fuel from Cape Breton to Upper Canada via the St. Lawrence are being diverted into other activities and if the traffic is to be handled it must be handled by rail.

Car Department Officers' Association

Hotel Sherman, Chicago

Tuesday, October 22

Morning Session

8:00 o'clock Registration.

10:00 o'clock Address by Col. Robert S. Henry, assistant to president, Association of American Railroads. (Joint meeting of co-ordinated associations).

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11:00 o'clock Meeting called to order.

11:05 o'clock Approval of minutes of last annual meeting.

11:15 o'clock President's address.

Afternoon Session

1:30 o'clock Reports of Membership Committees:
Northeast District—A. J. Krueger, general chairman.
Southeast district—E. S. Smith, general chairman.
Southwest district—F. E. Cheshire, general chairman.
Northwest district—G. R. Andersen, general chairman.

2:30 o'clock Report of Secretary-Treasurer.

3:30 o'clock Report of unfinished business.
Report of new business.

Wednesday, October 23

Morning Session

9:00 o'clock Report of Publicity Committee—E. L. Woodward, western editor, Railway Mechanical Engineer, chairman.

10:00 o'clock Address: Importance of the car department in the function of rail transportation, by J. M. Symes, general manager, Western Lines, Pennsylvania, and second vice-president, Indianapolis Union Ry.

10:30 o'clock Report of Freight and Passenger Car Construction and Maintenance Committee—D. J. Sheehan, superintendent motive power, Chicago & Eastern Illinois, chairman.

11:15 o'clock Report of Shop Operation, Facilities and Tools Committee—J. A. Deppe, superintendent car department, C. M. St. P. & P., chairman.

Afternoon Session

1:30 o'clock Report of Passenger Train Car Terminal Handling Committee—E. J. Hollahan, general car foreman, Illinois Central, chairman.

2:15 o'clock Report of Lubricants and Lubrication Committee—J. R. Brooks, supervisor lubrication and supplies, Chesapeake & Ohio, chairman.

Thursday, October 24

Morning Session

9:00 o'clock Report of Freight Car Inspection and Preparation for Commodity Loading Committee—F. J. Swanson, general car department supervisor, C. M. St. P. & P., chairman.

10:00 o'clock Address: Car maintenance, performance and expense, by O. A. Garber, chief mechanical officer, Missouri Pacific Lines.

10:30 o'clock Report of Interchange and Billing for Car Repairs Committee—M. E. Fitzgerald, master car builder, Chicago & Eastern Illinois, chairman.

Afternoon Session

1:30 o'clock Report of A.A.R. Loading Rules Committee—H. H. Golden, supervisor of A.A.R. interchange and accounting, L. & N., chairman.

Friday, October 25

Morning Session

9:00 o'clock Report of Painting Committee—C. L. Swing, general foreman, Pullman-Standard Car Mfg. Co., chairman.

10:00 o'clock Report of Booster Committee—Brad S. Johnson, sales engineer, W. H. Miner Inc., chairman.

10:30 o'clock Report of Reception Committee—W. J. Demmert, sales agent, Griffin Wheel Co., chairman.

11:30 o'clock Suggestions for good of the association.

Afternoon Session

2:00 o'clock Report of the Nominating Committee—J. E. Keegan, chief car inspector, Pennsylvania, chairman.
Election of officers.

Master Boiler Makers Association

Hotel Sherman, Chicago

Tuesday, October 22

Morning Session

8:45 o'clock Registration*
10:00 o'clock Joint meeting of the Co-ordinated Associations.

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10:45 o'clock President's address.
Remarks by L. B. Rhodes, president, Allied Railway Supply Association.

Afternoon Session

1:30 o'clock History of the Association by John A. Doarnberger.
Address by Dr. Edward C. Elliott, president, Purdue University.
Topic No. 2. Pitting and corrosion on firebox sheets and rivet heads
Discussion of topics for 1941 meeting

Wednesday, October 23

Morning Session

9:45 o'clock Business session.
Address by M. A. Quinn, general master mechanic, Delaware, Lackawanna & Western.
Topic No. 5. Application of iron, steel and alloy rivets with recommendations for heating and driving.
Illustrated paper by Ray McBrain, engineer of tests, Denver & Rio Grande Western, on Effects of service on carbon and alloy steel in the boiler and firebox and the aging of the material.

Afternoon Session

1:30 o'clock **Topic No. 3.** (Continued from 1939)—Improving circulation in the locomotive boiler—Increasing feedwater temperature—Deterimental effects on circulation due to improper firing practices—Proper firing up and cooling down of boilers—Design of new boilers to improve their water-carrying properties.
Secretary-Treasurer's report.
Committee on Law.

Thursday, October 24

Morning Session

9:30 o'clock Address by a railroad officer.
Topic No. 1. Use of acetylene and electric processes in the boiler shop.
Paper with illustrations by a committee of the International Acetylene Association, on Use of oxy-acetylene cutting and welding in the boiler shop.
Paper with illustrations by W. G. Theisinger, welding and metallurgical engineer, Lukens Steel Co., on Heat and mechanical stresses in welding and the forming and rolling of heads and plates.

Afternoon Session

1:30 o'clock **Topic No. 6.** (Continued from 1939). Longitudinal cracking of flues in service.
Topic No. 8. Tender-cistern maintenance practices.

Evening Session

7:30 o'clock Motion pictures. Joint showing by the co-ordinated associations.

Friday, October 25

Morning Session

9:30 o'clock **Topic No. 4.** (Continued from 1939). Chemical treatment of boiler feedwater.
Topic No. 7. Causes and control of cinder cutting.

Afternoon Session

1:30 o'clock Report of the Executive Board.
Report of the Committee on Law.
Election of officers.

*Beginning Monday, October 21, 5:00 p. m. to 6:00 p. m. and each day following, starting at 8:45 a. m.

Locomotive Maintenance Officers' Association

Hotel Sherman, Chicago

Tuesday, October 22

Morning Session

8:00 to 10:00 o'clock Registration.

10:00 o'clock
President's opening address and report.
Secretary-Treasurer's report.
Introduction of members present.
Appointment of Nominating Committee.

Afternoon Session

2:00 o'clock What Members of the L.M.O.A. Can Do to Improve the Service on All Railroads—Address by C. B. Hitch, superintendent of motive power, Chesapeake & Ohio.

Wednesday, October 23

Morning Session

9:30 o'clock The Design, Operation and Maintenance of Diesel Electric Locomotives, by H. V. Gill, supervisor of Diesel engines, Santa Fe System.

11:00 o'clock Future Locomotive Air Brake Maintenance, by J. P. Stewart, general supervisor air brakes, Missouri Pacific Lines.

Afternoon Session

2:00 o'clock Use of Modern Machinery and Tools in Locomotive Repairs—Address by D. J. Sheehan, superintendent motive power, Chicago & Eastern Illinois.

Thursday, October 24

Morning Session

9:30 o'clock Roundhouse Problems of the Present Day—Address by H. E. Hinds, assistant mechanical engineer, Chicago, Burlington & Quincy.
Election of Officers.

Afternoon Session

12:30 o'clock Luncheon in honor of Advisory Board.
Speaker: John M. Hall, director of Bureau of Locomotive Inspection, Interstate Commerce Commission, Washington, D. C. Subject: The Responsibility of the Locomotive Maintenance Officer and the Federal Inspector.
Remarks by Advisory Board Members:
O. A. Garber, chief mechanical officer, Missouri Pacific.
D. S. Ellis, chief mechanical officer, Chesapeake & Ohio.
J. Roberts, chief of motive power and car equipment, Canadian National.

Evening Session

7:30 o'clock Showing of educational motion pictures by the co-ordinated associations.

Friday, October 25

Morning Session

9:30 o'clock Maintenance of Locomotives on Long Runs, by Lee Robinson, superintendent of equipment, Illinois Central System.

Afternoon Session

2:00 o'clock
Secretary-Treasurer's report of convention.
Installation of new president and officers.
Outline for 1941.

Railway Fuel and Traveling Engineers' Association

Hotel Sherman, Chicago

Tuesday, October 22

Morning Session

10:00 o'clock — Opening ceremonies, including address by Col. Robert S. Henry, assistant to president, Association of American Railroads.

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11:15 o'clock — President's address.

11:30 o'clock — Appointment of special committees.

11:35 o'clock — Proportions of Steam Generated on Locomotive Boilers Used for Various Purposes, by E. E. Chapman, mechanical assistant, Atchison, Topeka & Santa Fe.

Afternoon Session

2:00 o'clock — Locomotive Firing Practice—Oil, by Roy W. Hunt, fuel supervisor, Atchison, Topeka & Santa Fe.
Locomotive Firing Practice—Coal, by W. C. Shove, general road foreman of engines, New York, New Haven & Hartford.

Wednesday, October 23—Mechanical Day

Morning Session

9:00 o'clock — New Locomotive Economy Devices, by A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific.

10:00 o'clock — Address by D. S. Ellis, chief mechanical officer, Chesapeake & Ohio.

10:45 o'clock — Utilization of motive power, by A. A. Raymond, superintendent fuel and locomotive performance, New York Central.

12:00 o'clock — Turbine and Condensing Locomotives, by L. P. Michael, chief mechanical engineer, Chicago & North Western.

Afternoon Session

2:00 o'clock — Report on New York Central Tests at Selkirk, by W. F. Collins, engineer of tests, New York Central.

Thursday, October 24—Air Brake Day

Morning Session

9:00 o'clock — Air Brakes, by J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe.
(A) Braking of freight trains of 100 or more cars.
(B) Description and operation of braking with HSC passenger brake equipment.

Afternoon Session

2:00 o'clock — Address on The Road Foreman and the Diesel Locomotive.

3:00 o'clock — Stationary Boiler Plants—Coal Fired, by E. G. Sanders, fuel conservation engineer, Atchison, Topeka & Santa Fe.

Friday, October 25—Fuel Day

Morning Session

9:00 o'clock — Who Uses and Wastes the Most Fuel, by J. G. Crawford, fuel engineer, Chicago, Burlington & Quincy.

9:40 o'clock — Fuel Economy from the Viewpoint of the Chief Dispatcher, by T. O. Weeks, Missouri Pacific.

10:10 o'clock — Fuel Records and Statistics, by E. E. Ramey, fuel engineer, Baltimore & Ohio.

10:40 o'clock — Coal Preparation, by S. A. Dickson, fuel supervisor, Alton.
Coal Film.
Elections.
Secretary-Treasurer's report.
Special Committee Reports—Subjects.

Allied Railway Supply Association

Hotel Sherman, Chicago

THE 90 railway supply manufacturing companies listed below are those which up to August 24 had contracted for space at the Exhibit of the Allied Railway Supply Association which will be held at the Hotel Sherman, Chicago, October 22 to 25, 1940. This Exhibit will be in conjunction with the four-day meetings of the Car Department Officers' Association, Locomotive Maintenance Officers' Association, Master Boiler Makers' Association and the Railway Fuel and Traveling Engineers' Association. The total of 90 companies, already represented, compares with the final total of 101 companies in October 1937, when the previous Exhibit was held. Many types of railway mechanical devices will be shown and it will be a valuable feature of the co-ordinated mechanical associations meetings

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Air Reduction Sales Company, New York
Ajax Hand Brake Company, Chicago
American Arch Company, Inc., New York
American Locomotive Company, New York
Apex Tool & Cutter Company, Inc., The, Shelton, Conn.
Arrow Tools, Inc., Chicago
Ashton Valve Company, The, Boston (Cambridge), Mass.
Baldwin Locomotive Works, The, Philadelphia, Pa.
Barco Manufacturing Company, Chicago
Beaver Pipe Tools, Inc., Warren, Ohio
Berkley Machine Works & Foundry Co., Inc., Norfolk, Va.
Buckeye Steel Castings Co., The, Columbus, Ohio
Byers Company, A. M., Pittsburgh, Pa.
Collins & Aikman Corporation, New York
Corley Company, The, Jersey City, N. J.
Crane Company, Chicago
The Dampney Company of America, Boston, Mass.
Dearborn Chemical Company, Chicago
Detroit Lubricator Company, Detroit, Mich.
Duff-Norton Manufacturing Company, The, Pittsburgh, Pa.
De-Wel Steel Products Company, Chicago
Edna Brass Manufacturing Company, The, Cincinnati, Ohio
Ewald Iron Company, Louisville, Ky.
Flannery Bolt Company, Bridgeville, Pa.
Franklin Railway Supply Co., Inc., New York
Gilg, Henry F., Pittsburgh, Pa.
Graham-White Sander Corporation, Roanoke, Va.
Griffin Wheel Company, Chicago
Grip Nut Company, Chicago
Hanna Stoker Company, The, Cincinnati, Ohio
Holland Company, Chicago
Hulson Grate Corporation, Keokuk, Iowa
Hunt-Spiller Manufacturing Corporation, South Boston, Mass.
Huron Manufacturing Company, Detroit, Mich.
International Correspondence Schools, Scranton, Pa.
Johns-Manville Sales Corporation, New York
Lehon Company, The, Chicago
Lewis Bolt & Nut Co., Minneapolis, Minn.
Lima Locomotive Works, Inc., Lima, Ohio
Locomotive Firebox Company, Chicago
Lunkenheimer Company, The, Cincinnati, Ohio
MacLean-Fogg Lock Nut Company, Chicago
Mall Tool Company, Chicago
Miner, Inc., W. H., Chicago
Monarch Packing & Supply Co., Chicago
Morton Manufacturing Company, Chicago
Murdock Manufacturing & Supply Co., Cincinnati, Ohio
Nathan Manufacturing Company, New York
National Aluminate Corporation, Chicago
National Malleable & Steel Castings Co., Cleveland, Ohio
Oakite Products, Inc., New York
Ohio Injector Company of Illinois, The, Chicago
Okadee Company, Chicago
O'Malley Valve Company, Edward, Chicago
Oxweld Railroad Service Company, The, Chicago
Paxton-Mitchell Company, Omaha, Neb.
Penn Iron & Steel Company, Creighton, Pa.
Pilliod Company, New York
Pocket List of Railroad Officials, The, New York
Portable Equipment Company, Chicago
Prime Manufacturing Company, The, Milwaukee, Wis.
Pyle-National Company, The, Chicago
Q & C Company, New York
Railway Purchases and Stores, Chicago
Ryerson, & Son, Inc., Joseph T., Chicago
Sellers, Wm. & Co., Inc., Philadelphia, Pa.
Simmons-Boardman Publishing Corporation, New York
Sinkler, Inc., Joseph Inc., Chicago
Spring Packing Corporation, Chicago
Standard Brake Shoe & Foundry Company, Chicago
Standard Car Sales, Inc., Chicago
Standard Car Truck Company, Chicago
Standard Stoker Co., Inc., The, New York
Superheater Company, The, New York
Superior Hand Brake Company, Chicago
Superior Railway Products Corporation, Pittsburgh, Pa.
Swanson Company, The, Chicago
Talmage Manufacturing Co., The, Cleveland, Ohio
Timken Roller Bearing Company, The, Canton, Ohio
T-Z Railway Equipment Company, Chicago
Union Asbestos & Rubber Co., Chicago
United States Metallic Packing Company, Philadelphia, Pa.
Unit Truck Corporation, Jersey City, N. J.
Valve Pilot Corporation, New York
Vapor Car Heating Company, Inc., Chicago
Viloco Railway Equipment Company, Chicago
Westinghouse Air Brake Company, Wilmerding, Pa.
Wilson Engineering Corporation, Chicago
Wine Railway Appliance Company, The, Toledo, Ohio
Worthington Pump & Machinery Corp., Harrison, N. J.

EDITORIALS

Half-Century of Achievement

The fiftieth birthday of the New York Air Brake Company, on July 1, 1940, is recorded in a brochure issued by that company which recalls, in illustration and text, a number of interesting events in the history of American air-brake development. Many of the younger generation of railroad men are probably unaware that 64 years ago the predecessor of the present company was organized to exploit the development of a competitor of the air brake. The Eames vacuum brake was a successful device. Although rapidly superseded in America following the successful demonstration of the air brake of George Westinghouse in the famous Burlington Brake Trials of 1887, the vacuum brake is still in use in other countries, and a part of the current business of the present company is supplying vacuum brakes to certain foreign railroads.

During the last World War, like so many other railway equipment and supply manufacturers, the New York Air Brake Company participated in the business of manufacturing munitions for the Allied governments. The brochure significantly points out that having done so, the company was ready to assist the government of the United States when it entered the European conflict.

One of the great difficulties our national government is facing today, that is, the necessity of expanding plant and personnel for the purpose of producing large outputs of non-commercial goods for a period of uncertain but relatively short duration, was taken care of by the process of business negotiation between our industries and certain foreign governments in the first World War. Something of the proportions of the problem thus solved in the first World War may be gained by this company's experience, which expanded a "normal modern complement" of 1,500 employees to a maximum of 4,500 during the war years.

The program of training required to effect such expansions in personnel cannot be carried out in a day, even though the need is for specialists rather than journeymen mechanics. Nor can the investment in plant and equipment expansion required to provide the tools for the expanded forces of workers in industry be properly considered as a burden on peace-time activities or as the cost of peace-time defense; in the present emergency proportions it can properly be considered only as a part of the price of war, even though we are not now and may not be in the present World War.

The simple statement of the New York Air Brake Company's part in the manufacture of munitions during the first World War, suggests strongly that the efforts of our isolationists to keep us from all contact with the present World War have succeeded principally in greatly complicating our problems, now that we have become aware, as a nation, that our safety can be assured only by the force of arms.

Treated Wood For Car Lumber

Treated wood has been used for car lumber to some extent on American railroads for many years, but it may well be doubted if lumber, treated by any of the several recognized methods now available to prolong its effective service life, is being incorporated in car construction as extensively as it should be, based on purely economic considerations. The increased use of treated car lumber, including its application to a considerable number of new cars built during the past year, does, however, indicate a growing appreciation of the potential advantages of this material in reducing car maintenance costs.

Some interesting information regarding the use of treated car lumber is included in a recent committee report to the American Wood Preservers' Association, which points out that the St. Louis-San Francisco, for example, uses annually substantial quantities of pressure-treated lumber for the decks of open-type cars, wood members of stock cars and siding for coal cars. In this case, the coal car decks and sides are creosoted and other members salt-treated. The Central of Georgia uses a considerable amount of creosoted wood for coal car decks and for all wood parts of stock cars, including running boards. The Louisville & Nashville is reported to have adopted a standard list of car members to be treated for use in stock, gondola and flat cars. The Santa Fe has standardized on creosoted decking and nailing stringers for flat cars, lumber for these purposes being cut to size before treatment.

In general, there are three factors which limit to a certain extent the wide adaptation of treated lumber for use in railway car equipment; namely, the cost of the treatment, physical characteristics of the individual treatments some of which may be objectionable for certain purposes, and the fact that, for best results, the lumber needs to be preframed before treatment. This involves rather drastic standardization of lumber sizes and also introduces some complications into the problem of repairs and replacements at other than central repair shops.

One of the tables included in the report referred to

shows, for example, a total of 424 pieces of lumber in a single stock car, varying in size from 38½-ft. side sills to 3-in. by 3¾-in. by 4¼-in. ladder cripples, the largest number of individual pieces of a given size being 180 $^{15}/_{16}$-in. by 5¼-in. by 5-ft. roofing boards. Car lumber parts which are widely used can be pre-cut, treated and made generally available at system repair points, but it would hardly be feasible to have all of the 30 different items in stock, some of which probably would seldom if ever be used. Moreover, even freight cars of the same series often vary slightly in certain detail dimensions, so that preframed lumber, while made to standard dimensions, might not fit exactly when being applied for replacement purposes. This would mean cutting the lumber subsequent to treatment, thus reducing to some extent the protection afforded by the preservative treatment.

On one railroad that now uses treated flooring, stringer and furrings for flat cars, specified creosote treatment by the Rueping process is given to especially-selected lumber, milled to dimensions before treatment. When renewing the decking on these cars, a ¼-in. air space is left between adjoining planks to facilitate drainage, cement-coated wire nails and bolts being used to secure the lumber properly in place. Before the treated lumber is applied, the steel is thoroughly cleaned and painted in accordance with recognized practice.

To summarize, treated lumber has been successfully used for many car parts, and the greatest economy is secured when it replaces lumber which fails principally as a direct result of decay, or which becomes weakened sufficiently by partial decay to lower its inherent resistance to mechanical shock. In general, the various car parts best adapted to be made of treated lumber include all wood members of stock cars; composite gondola car sides, decks and nailing stringers; flat car decks and nailing stringers. Experience clearly indicates that, with due regard to the limitations of the various processes, the treatment of wood for car lumber is definitely advantageous and can be profitably followed to an increasing extent in the construction of railway equipment.

Evidence of a Change of Mind

For some time in the past the railroads of the country have been rather backward in matter of expenditures for the modernization of shops and enginehouses and have justified such a course on the ground that limited earnings have made it desirable to get the most out of shop equipment that in many cases has outlived its usefulness. The demand for greater accuracy in machine work and the proved ability of modern machine tools and shop equipment to pay for itself in a surprisingly short time have evidently convinced a number of mechanical officers that it is well worth while to put into effect a program of shop equipment replacement. Reports from various sources indicate decided activity in shop equipment buying.

A Cost Study Worth Continuing

Since 1925 the railroads of the United States have invested over 60 millions of dollars in Diesel powered locomotives and rail cars, and the question concerning the cost of operation of this type of equipment is one of vital concern to all who are responsible for its use.

The introduction of Diesel motive power in the railroad field was first justified, by its proponents, on the basis that it would provide a more economical form of power than steam, and as the installations increased in number in the succeeding years it became evident that there was considerable merit to this claim. It also became evident that, when comparisons were made, Diesel and steam costs had to be considered from the standpoint of operating costs, on the one hand, and fixed charges, on the other.

The higher initial cost of Diesel power might conceivably offset the advantages of lower operating costs unless the facility was used in a class of service where its high availability and high utilization factor would result in a low "per-hour" or "per-mile" cost. In this respect the problem of Diesel power in rail transportation is not in any sense different than that of steam or electric motive power—it is, after all, a problem in which the principal consideration is one of economics. In the light of that consideration it would seem that the development of accurate cost statistics with respect to the use of Diesel power should be a task of major importance; one of exceptional value not only to the roads that have already installed that type of power but also to those that may have such installations in contemplation.

In 1932 the Mechanical Division of the Association of American Railroads, through the activities of a sub-committee of the Locomotive Construction Committee prepared a study of Diesel operating costs. The fact that there were those who took exception to some of the figures embodied in that report did not in the least detract from the value of the work of the sub-committee. Its report presented facts concerning Diesel costs as they existed at that time. The report, under the circumstances provided a valuable basis for comparison with future similar studies.

In 1939 a similar A. A. R. Mechanical Division sub-committee prepared a Diesel cost report covering a six-month period of operation of 600-hp. switching locomotives. In a 1940 report to the Division it expanded the scope of its report to include a full 12-month period of both 600- and 900-hp. switchers. Thus, in a period of 15 years of operation of Diesel motive power the co-ordinated cost studies on this type of railroad

motive power operation are embraced in rather limited statistical data. The primary purpose of further discussion of this subject is to emphasize again the need for more complete data.

In an editorial which appeared in the July issue of *Railway Mechanical Engineer,* page 288, comment was made on the work of the sub-committee with respect to its 1940 report. That discussion was intended to convey an expression of opinion to the effect that the data already developed by the sub-committee were of definite value to the industry but that in spite of the fact that an excellent start had been made the required data are not by any means complete. In that discussion comment was made on the recommendation of the sub-committee to suspend, temporarily, its activities on the ground that sufficient information is available to justify such a course.

It is to such a recommendation that exception is taken on the basis that a break in the continuity of the cost data will adversely affect the value of future records. This exception is taken with full recognition of the fact that many conditions surrounding the operation of Diesel motive power at the present time may be such as to preclude the possibility of developing the kind of cost data that may be available when the time has arrived that Diesel operation has become more of a routine matter.

The previous editorial comment did not offer any suggestion as to the agency best qualified to make future studies of the cost of railroad Diesel motive power operation. It did, however, take exception to the previously-mentioned sub-committee recommendation and point to the interest of the A. S. M. E. in the subject as evidence of a growing, rather than a declining interest in such cost studies.

On the Reader's Page of this issue Lawford H. Fry, chairman of the Railroad Division of the A. S. M. E., has placed the position of that group on record. Mr. Fry questions the value of immediately continuing the collection of cost statistics and suggests that the A. A. R. Mechanical Division is the proper agency to do the job when the time comes. With this latter suggestion no reasonable exception can be taken and in view of the widespread interest in the subject it is hoped that the Mechanical Division will see its way clear to perpetuate the record already compiled. The important thing is to have the job done.

New Books

WHO'S WHO IN RAILROADING IN NORTH AMERICA. *716 pages. 8¾ in. by 5¾ in. Bound in cloth. Published by the Simmons-Boardman Publishing Corporation, New York. Price $7.50.*

The 1940 edition of "Who's Who in Railroading" is off the presses. Containing 5,300 biographical sketches of leaders in the field, as compared with some 3,800 contained in the previous edition, the new book brings up to date the hierarchy of the railroad transportation world after a ten-year interval. When the 1930 edition was brought out it was the intention to publish revised editions at intervals of about three years, but the economic depression made such a program impossible. Hence this new edition "takes up the slack" after a decade of manifold changes in the railroad business and its personnel.

The 1940 edition further extends the policy first followed in its predecessor of broadening coverage to leaders among the equipment and supply companies, railroad labor leaders, state and federal regulatory authorities, transportation economists, specialists in railway finance, educators, I. C. C. practitioners, consultants, authors, editors and other experts. Naturally, the inclusion of leaders outside of railroad personnel proper brought with it a difficult task of selection requiring a wide knowledge of the field. To accomplish this and capitalize on the experience of a large group of observers, the combined staffs of the five Simmons-Boardman railroad periodicals were consulted for recommendations and in the case of highly specialized groups outside authorities were asked for selections.

The 1940 edition also carries on the policy initiated in 1930 of "personalizing" the biographical sketches by the addition of family data, social, political and religious affiliations, etc., to the more formal career statements.

"Who's Who in Railroading" is a lineal descendant of the well-known "Biographical Directory of Railway Officials of America," the first edition of which appeared in 1885. Subsequent editions were published in 1887, 1893, 1896, 1901, 1906, 1913 and 1922.

SMOKE PREVENTION. *Manual of Ordinances and requirements in the interest of reduced air pollution, smoke elimination and fuel economy. 160 pages, 5 in. by 8 in., bound in paper. Published by the Smoke Prevention Association of America, Inc., 139 N. Clark street, Chicago. Price, 60 cents.*

This well-illustrated book contains, in addition to a report of the association's annual meeting, May 21-24, 1940, at St. Louis, Mo., a large amount of specific data describing methods of measuring air pollution, promoting fuel economy and developing a constructive approach to all phases of the problem of smoke elimination.

The book is of unusual interest to railway officers because of the considerable number of papers on specific railroad subjects that were presented at the May meeting as follows: Methods Employed by the Railroads in Eliminating Smoke, by H. J. Riddle, division road foreman of engines, Pennsylvania, St. Louis, Mo.; Locomotive Smoke Abatement, by William G. Christy, smoke abatement engineer, Hudson County, N. J.; How the Railroads Are Attacking the Smoke Problem, by R. C. White, assistant general manager, Missouri Pacific, St. Louis, Mo., and Future Outlook for the Prevention of Smoke from Railroad Locomotives, by D. C. Buell, Railway Educational Bureau, Omaha, Neb.

THE READER'S PAGE

The Question of Diesel Costs

To the Editor:

The editorial on page 289 of your July issue on Diesel locomotive operation calls attention to the excellent report of the Locomotive Construction Committee of the A. A. R. Mechanical Division. As chairman of the Railroad Division of the American Society of Mechanical Engineers, may I offer a word of clarification regarding the last paragraph, which suggests that the A. S. M. E. should participate in further study of the costs of Diesel locomotive operation.

The Oil and Gas Power Division of the A. S. M. E. has been studying for some years the cost of operation of stationary Diesel engines and, with the growing use of the Diesel locomotive, has felt that study might be extended to this field. Preliminary consideration shows that the A. A. R. Locomotive Construction Committee has covered the situation very completely, and the report drafted by the A. S. M. E. committee uses the very complete data of the A. A. R. report and will make this excellent work available to a wider circle of engineers.

The application of Diesel power to locomotive service is in a state of flux and development; and before further cost statistics are collected, time should be allowed for clarification. This is a matter which should be properly left in the competent hands of the appropriate A. A. R. committees.

The Railroad Division of the A. S. M. E. hopes that cooperation with the A. A. R. Mechanical Division on this and other subjects may be possible in the future.

Lawford H. Fry,
Chairman, Railroad Division,
American Society of Mechanical Engineers.

Damaging Effects of Water in the Cylinders

To the Editor:

After reading the published accounts and studying the photographs of the deplorable wreck on the New York Central at Little Falls, New York, I awaited the official report as to the cause.

During my years of experience as a machinist and mechanical officer in railroad service, I have investigated and reviewed many accidents to locomotives and trains. I have seen the damaged locomotives after two of them had met, head-on, at approximately 50 m. p. h.; also when they met at an angle. I have seen them after a boiler explosion where the boiler was torn from its fastenings and hurled into the field beyond the right-of-way. I cannot recall a case where the destruction was as complete as indicated by the photographs of the N. Y. C. wreck. Heavy locomotive frames were broken by tension, and cylinders and saddle were torn from the boiler, indicating a force greater and different from what we would expect when a heavy train traveling 60 m. p. h. would strike a stationary object.

What Could Have Caused This Accident?

Years ago, as a machinist on the Burlington, I was detailed on experimental work at one of its important terminals. We found piston-rod keys would shear in the crossheads, and that piston rods would be driven into the crosshead so tight we had to design special tools to separate them. Cylinder packing was broken; cylinder heads broken and sections pulled out of the cylinders. Strengthening the weak parts transferred the breakage elsewhere.

Water in the cylinder was the cause. We started a campaign of supervision and instruction by the traveling engineers and traveling firemen. This did not effect a cure, due to that inborn fear of low water on the crown sheet, but it did reduce the accidents.

Water is incompressible. Now, picture water between the piston and front cylinder head on an engine with rings and parts proof against leakage. The locomotive with the momentum of a heavy train may be traveling at 60 m. p. h., drivers 300 r. p. m., crosshead pin traveling an average speed of 1,500 ft. per min.

Assume a volume of water completely fills the space between the piston and front cylinder head when the piston is 8 in., 6 in. or 4 in. from its extreme forward travel. At this point the crank pin is approaching the dead center where the power applied is tremendous. One familiar with the laws of physics can well understand how a force built up under this condition can tear a locomotive frame in two, rip the cylinders and saddle from the boiler, thus releasing water and steam and apparently indicating a boiler explosion. One may say the main rod would buckle. Remember this happens in a minute fraction of a second—"velocity." It is velocity that enables a tallow candle to penetrate a wooden plank. It is velocity that enables a straw to penetrate the trunk of trees during heavy windstorms.

Recently, a new locomotive out of the shop, in service, stripped itself completely. Crank pins were partly pulled from wheels, wheels were loosed on axles, rods were peculiarly bent—a clear case of water, though the investigators gave a different decision.

Read the 1940 Mechanical Division Committee report on checks, cracks and breakages in crank pins, axles, main and piston rods. We experienced these same troubles. I could include scored cylinders, broken valve and cylinder packing, and many others. This trouble has existed from the advent of the steam engine. Its effects become more disastrous as speed increases.

Enginemen, in the interest of self-preservation and safety first, abhor low water. The tendency is to carry water above the safe maximum high. Automatic feeds sometimes fail to maintain this desired level. When the superheater was adopted, it was thought this trouble would disappear but it was found the enginemen in their desire to avoid scorched crown sheets carried the water at a higher level, necessitating further individual instruction.

Eternal vigilance and constant instruction by properly trained, practical men is the answer. High water level in the boiler always leaves its mark. Unless it is corrected, trouble is sure to follow.

M. D. Franey

No Place for Complacency

To the Editor:

Your editorial on boiler explosions in the February *Railway Mechanical Engineer* is a timely presentation of a subject only too often passed over in obvious haste. The final sentence is especially worthy of careful attention from supervisory officers.

Your readers probably remember the disastrous explosion of a Northern Pacific Class Z-6 articulated locomotive in July, 1938.* I sent a copy of the official I. C. C. report on this explosion to an old friend who was for many years director of locomotive design and construction at one of the largest plants in Germany. A portion of his comments, freely translated, may be of interest:

"In Germany, we have at the most *one* explosion every three or four years. But, when I read this report, I do not wonder at the many explosions in America. Here, the lowest permissible water level is 100 mm. ($3\frac{15}{16}$ in.) as against 3 in. in the U. S. A., but the latter figure is only nominal since the report shows measurements of $2\frac{3}{8}$ in. This is careless construction. Staybolt spacing here is usually not over 85 mm. ($3\frac{3}{8}$ in.) as compared with 4 in. in the U. S. A.

"Three men on the locomotive did not hear the alarm whistle! Or did it perhaps not function? In all of Europe we have not one alarm whistle . . . For a full two weeks defective working of the pump was complained of almost daily and just as often the prescribed repairs were vouched for. And what all they did find in the water tank! At the same time the water glasses were apparently all in order. Such unbelievable carelessness on the part of the personnel! At any rate, the report casts a deplorable light on American locomotive construction and operation."

There are a little less than half as many steam locomotives in Germany as in the United States, a fact which accounts for some part of the difference in frequency of boiler explosions. But much of the difference must also be credited to the rigid system of inspection and discipline instituted by the security police, under whose jurisdiction steam boilers were placed as early as 1850. This extreme care in inspecting, testing and operating boilers has been continued by the railway officers until the present day. It is doubtful, however, if the discipline imposed on the shop and road forces would be practical in America.

The closer staybolt spacing in German boilers is no doubt due to the use of copper for inner firebox sheets. They have never been able to use steel with conspicuous success. Some thought might profitably be applied to a study of the lowest permissible water level. In the huge boilers of today, with their tremendous evaporative capacity, 3 in. is little more than a film of water above the crown sheet. Another inch might well be added, if only as a precaution against errors in construction which are sometimes found in boilers emanating from shops of the highest reputation.

It is pleasing to note your rejection of the complacent view that four or five explosions per year might be considered an irreducible minimum. Those who hold that opinion (and there are a few) will sooner or later arrive at the state of mind which E. L. Ahrons once described as characteristic of the early native officers in Egypt. When a boiler blew up in those day, the railwaymen were told: "Never mind. Get another engine. Allah wished that one to come to grief, and lo!; see what has happened to it."

Wm. T. Hoecker.

* An editorial commenting on this appeared in the November, 1938, *Railway Mechanical Engineer*, page 453.

Determining Boiler Capacity

To the Editor:

We notice a rather frequently asked question regarding boiler capacities, etc., on page 330 of your August, 1940, issue under the title "Locomotive Boiler Questions and Answers." While the answer given is quite comprehensive, we feel that some of the information is incorrect or considered obsolete, particularly for modern power.

Boiler evaporation is, as stated, based on the flue and tube surface area and the direct or radiant surface area of the firebox and combustion chamber. However, we now use the total tube and flue heating surface and multiply this by an evaporation factor varying from 13 lb. for a 10-ft. length to 8.2 lb. for a 24-ft. length, and while we are still using a 55-lb. rate for the furnace in general, we frequently use 90 lb. for very large power. Tests have shown many times and numerous articles have frequently pointed out the excess of actual power developed over the theoretical, hence the Locomotive Institute is seriously considering the 80-lb. rate, on the basis of which tests are closely approximated.

Consideration must be given to locomotive proportions, such as brick arches, combustion chambers, syphons, and the capability of the grate to supply the necessary heat. After all, the grate is the basic factor and must always be checked. Feedwater heaters must also be considered, as they increase evaporation by eight per cent or better.

On steam switchers, evaporation is always based on the grate since the intense combustion developed in road locomotives produces high rates of evaporation which are never attained on switchers because of their lack of design features and the relatively slow speeds at which they operate.

As to the injector capacity on large locomotives, it must be borne in mind that one injector or the feedwater heater may fail, and the spare injector must assume the full burden. Therefore, we deem it advisable to provide injectors, each of which can supply an adequate quantity of boiler feedwater.

Today, maximum horsepowers are developed at speeds far in excess of 1,000 ft. per min., and saturated locomotives in road service and even switchers are practically extinct. Modern locomotives are considered to develop maximum horsepower at piston speeds of about 1,500 ft. per min. In fact, in actual service this speed may approach 2,000 ft. per min.

The latest edition of our book, Locomotive Data, explains in considerable detail a generally accepted method for preliminary locomotive calculations.

Cole's ratios in their original form are generally conceded to be antiquated, and frequently, when certain forms of technical information are published, it is followed without the tempering effect of experience. Considerable difficulty is often encountered in convincing some calculators of the inadequacy of a method that may have been adopted from some publication and have them accept one along contemporary lines.

Edward J. Harley,
Assistant chief engineer,
Baldwin Locomotive Works.

Stenciled Advertising On Freight Equipment

In December, 1939, the Atchison, Topeka & Santa Fe decided to utilize the space on freight equipment, not taken up by the necessary reporting marks and A. A. R. data, for advertising the principal trains and service of the Santa Fe system, and a program of applying this material was begun, which, when finally completed, will embrace a total of 27,984 box, automobile and refrigerator cars.

Through a process of trial and elimination, it was decided to utilize only the equipment which presented smooth sides for this application, several attempts at placing this upon cars with exposed side posts and recessed side posts having resulted in unfavorable appearance.

From the standpoint of neatness and legibility, a method of application had to be found which would give, first, the details of the design of lettering used in the material; second, clean, sharp lines and edges; and third, relatively low cost per individual application through a fast time-saving and labor-saving process. It was decided to use stencils as the method most suitable to comply with all three requirements, and to use them with paint spray guns for applying the paint.

These stencils were first made from zinc sheets which were etched by acid in the conventional manner used for all stencils of this type. These designs were photostated at an exact size of one inch per foot scale in relation to the actual size selected for the space available on the sides of the equipment. These photostats were then carefully scaled up in every detail on a working drawing and blueprinted for the stencil cutters. The prints were then used by the stencil cutters to lay out each sign full size on paper patterns.

The signs selected by the Santa Fe are as follows: A skeleton map of the Santa Fe system showing the principal terminals and intermediate large cities and the words "Santa Fe All the Way" laid on the map as a background so that "Santa Fe" identifies the map instantly and the slogan "All the Way" interprets the significance of the map. This is placed on the right side of each car which receives the advertising material and is made in two sizes, 12 ft. 6 in. by 6 ft. for cars 40 ft. in length and 17 ft. by 7 ft. for cars 50 ft. in length.

For the left side of each car, there are five selected signs advertising the most famous trains and carrying the message to all of their respective special merits. These signs are: "The Grand Canyon Line," a slogan identified with the Santa Fe system for many years; "The Scout, for Economy Travel West," which describes the famous economy service of this train; "El Capitan, Coach Streamliner West," which is the only exclusive coach streamliner in service between Chicago and Los Angeles; "The Super Chief to California," which carries the story simply and effectively; and "The Chief, Famous Daily Streamliner, West," which completely describes the famous Chief, now in operation since 1926 and the only daily streamliner to California. These signs are also made in two sizes, 12 ft. 8 in. long by 6 ft. high for cars 40 ft. in length, and 15 ft. 6 in. by 7 ft. for cars 50 ft. in length.

The letters and design of these signs are both powerful and legible, due to the thick stems and well-proportioned width and height of each letter. Lower-case styles are used except for necessary capital letters, and in a few cases the words are in italic style for greater emphasis through variety of form. Visibility and legibility of the signs are therefore at a maximum.

Two colors of paint are used as follows: on all refrigerator cars which have orange yellow body paint, the signs are in black enamel, which gives a combination most easily read at a distance. The box and automobile cars which have red body paint have signs ap-

One of five selected signs now being placed on the left side of system-owned house cars to advertise famous Santa Fe scenic routes and special trains

Railroad insignia, skeleton map and slogan now being stenciled on the right side of Santa Fe box and refrigerator cars

plied in white mineral paint, which is a good combination for legibility and contrast.

The paper patterns when laid out full size are traced on zinc sheets covered with lead foil, and the foil is removed where the body of the letter is cut out. This surface is then etched out by immersing in acid. As the stencils are quite large, it was a long task to use this process, so a machine was purchased and at present the signs are cut directly from tracings on the zinc sheet, without the use of lead foil or etching, and the time and cost of each stencil was reduced as compared with the old method.

As the signs advertising trains are to be proportioned out equally over all the cars, it is seen that each of them will be used only one-fifth as much as the map stencil. Therefore, the signs advertising the trains are now made of No. 300 red stencil paper framed in popular wood and the "ties" in letters and the surface of the stencil stiffened by taut piano wires passing from one side of the frame to the other. The stencil is processed with linseed oil and two coats of clear lacquer, and the piano wires are held to the "ties" by Comet cement. This method of preparing a stencil has the advantage of lightness, and costs one-quarter as much as a zinc stencil.

The stencils are applied in a few minutes by the use of suitable brackets and hangers which place them in the proper location on the car and accurately, and in instant readiness for the spraying on of the paint.

This campaign of advertising the Santa Fe and its trains is being carried out with dispatch. The cars to be stenciled will include 2,000 40-ft. box cars and 200 50-ft. automobile cars being rebuilt at Topeka Shops, as well as 1,800 new box cars received from the Pullman-Standard Car Manufacturing Company and 450 refrigerator cars received from the General American Transportation Corporation.

Unit Mechanically Cleans Tank-Car Interiors

*By L. B. Johnson**

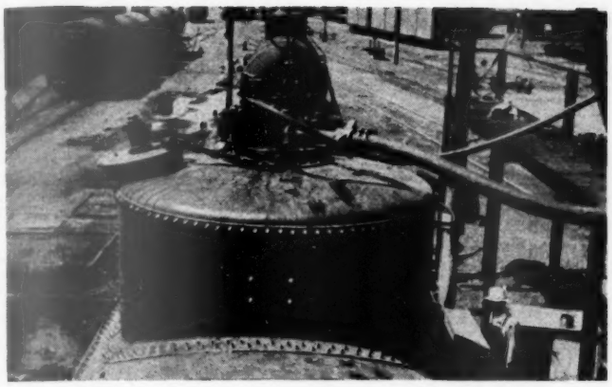
The railroads are becoming increasingly interested in new and modern cost-reducing equipment, particularly for use in departments where there is a substantial volume of identical units to be maintained or produced. An interesting development illustrating this is a new tank-car interior cleaner that in actual use has demonstrated its ability to speed up tank-car cleaning and reduce maintenance costs on this type of work by over 50 per cent. With the national defense program gaining speed and momentum and the likelihood of greater demands being placed on the railroads for transportation facilities, the significance of this contribution to increased efficiency and in speeding up maintenance in this one instance is quite apparent.

Executives in charge of rolling stock are familiar with the fact that cleaning the interior of tank-cars used for the transportation of crude, fuel, stove or various vegetable oils and similar liquid products has been considered both a disagreeable and an expensive job. In general, the procedure usually followed to clean the interior of a tank car that has carried heavy crude oil is, first, to steam out the car to "kill" any gases present and to make it safe for men to enter to scrub or scrape interior surfaces and to muck out heavy deposits. The time required for steaming usually varies according to the demand for cars. In many cases, cars are steamed overnight. In others, the period of preliminary steaming is shorter, but it is an operation in which considerable time is expended before workmen enter car and start the actual, physical cleaning. After steaming, one method followed is to scrape the sides where necessary, and then scrub with a solution of caustic soda or similar raw alkali. Sometimes hydro-carbon solvents, in addition, are employed to obtain the desired degree of cleanliness. After scraping and scrubbing operations, usual rinsing follows, but often when the job was presumably completed, inspection revealed that it was necessary to go over surfaces again due to oil spots and other deposits remaining in the seams of plates that men either failed to see or did not remove during the first cleaning operation.

There are four main objectives to be considered in connection with tank-car cleaning: (1) Interior surfaces of tank car must be thoroughly clean; (2) method used must do the work speedily; (3) cost should be low, and (4) the method employed should be safe. That a device is available which meets these four main requirements is an achievement of more than usual importance, and since it includes many original features in its design and operation, it has been granted U. S. Patent protection. The device or machine is known as the Oakite interior tank cleaning unit, Model 324. When used with the recommended Oakite material it is possible mechanically to clean an average tank car which has carried crude oil, without the necessity of a preliminary steaming operation, in from 1½ to 2 hr., depending on the condition of the tank. In other words, deposits are removed mechanically instead of manually. The actual time of cleaning by the unit ranges from 20

Auxiliary equipment includes crane for lifting unit, platform, duplex pump and piping for carrying cleaning solution

* Manager, service department, Oakite Products, Inc.



Oakite interior tank-car cleaning unit installed in the car dome

to 40 minutes. The remaining time is taken up by necessary rinsing operations with hot and cold water. Compared with manual method of cleaning, the results obtained are far superior.

This cleaning unit is an automatic, motor-operated machine, developed by the Oakite engineering staff. The unit is substantially constructed and designed so as to eliminate fire hazard from sparks. Its motor is air operated, requiring a pressure of 50 lb. per sq. in.

Sequence of Operations

The unit is hung from a light crane and counter-balanced with a weight so that it may be lowered with one hand, into the dome of a tank car. Air and solution hoses are permanently connected. The unit may be lowered and bolted to the dome of car by special clamps, which are regular equipment, by one man in less than two minutes. When installed, the revolving nozzles of the unit are located midway between the top and bottom surfaces of the tank car being cleaned. A cleaning solution is delivered to the unit at a pressure of 100 lb. per sq. in. by a 10-in. by 6-in. by 10-in. steam-operated duplex pump. The cleaning solution and hot water rinse previously referred to are taken from two 1,000-gal. tanks fitted with hinged covers and set flush with the ground. These tanks are heated with steam coils, the solution being piped through a steam-operated duplex pump to the cleaning unit, so that either solution may be used as required. The cold rinse is taken direct from the regular supply.

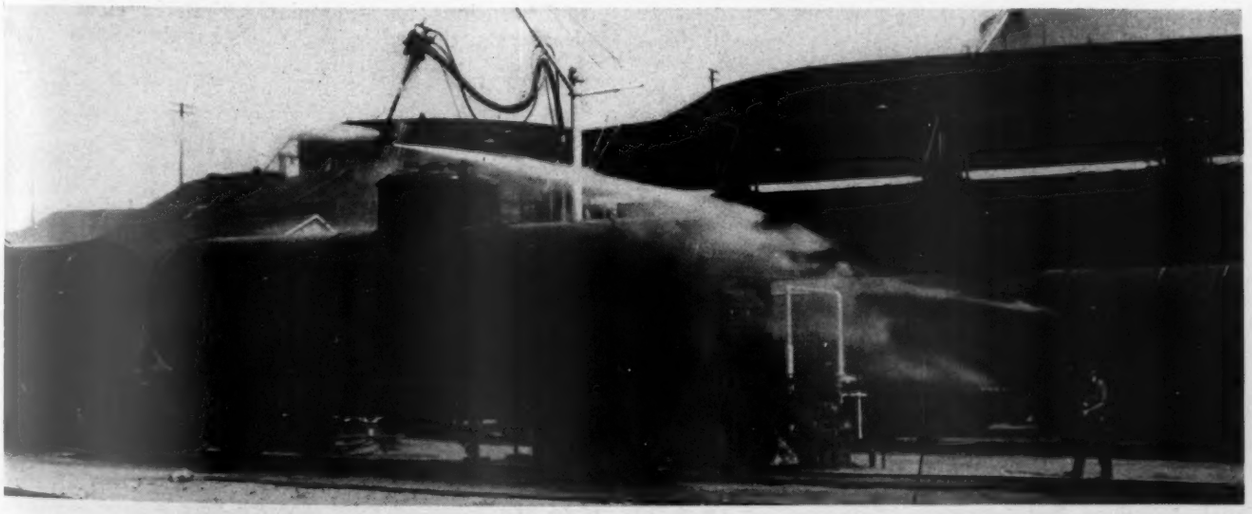
Entire Interior Surface Reached

The hot cleaning solution is delivered by the two nozzles which slowly revolve in two concentric circles starting with one nozzle pointing straight up and the other down. During the cleaning operation, the two high pressure streams from nozzles are delivered against every square inch of the interior surface of the tank car being cleaned. These high pressure streams of hot solution remove the most tenacious dried-on oils and deposits due to their knife-like cutting and cleaning action.

As the operation proceeds, the cleaning solution runs down the inside surfaces of the tank car where it falls or flows by gravity through the dump valve to a catch box made up of light-gage sheet steel. From there the solution in turn flows back through an underground pipe into the 1,000-gal. main tank. Thus the same cleaning solution is re-circulated and used over and over again. The hot rinse is re-used in the same way as the cleaning solution.

After the unit has been in operation for from 20 to 40 minutes, the latter period of time only being necessary where exceptionally dirty cars are to be cleaned, a hot and then cold water rinse follows. These rinsing operations are, as previously noted, performed by the same unit. After the hot and cold rinsing, the tank car will be found entirely free of any gas or oil odor. Where a car has not been cleaned for an unusually long period or where deposits are of an unusually heavy character, a small amount of inert matter may be found on the bottom at each end of the car, but this may be easily removed by one operator scraping and then flushing deposits out with a hand hose. The time required, where a condition like this may be found, will range from 20 to 30 minutes, but the total time for complete tank-car cleaning operation, based on actual experience, does not exceed two hours.

The cleaning of gasoline tank cars either for repairs, such as re-grinding valves, removing rust and scale, or for change-over to another type of liquid product, is accomplished with unusual speed and thoroughness when the Oakite Model 324 unit is used. Here again the necessity for preliminary steaming to get rid of volatile gasoline fumes and vapors is entirely eliminated. Moreover, the high pressure stream of Oakite cleaning solution from the two slowly revolving nozzles removes loose rust and scale so that any manual work, that may be required to complete scale and rust removal, is reduced to a minimum.



Powerful ejection of stream of boiling cleaning solution is shown by the distance and angle of the spray

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Unrepaired and Improperly Repaired Damage to Car

During November, 1938, St. Louis-San Francisco box car 127813 was derailed and damaged on the Missouri & Arkansas. At the request of the M. & A., the St. L.-S. F. shipped two door castings and two door-track castings to the M. & A., account handling-line defects, and were advised that the car would be repaired and returned to service by December 15, 1938. On January 1, 1939, this car was received empty by the owner at St. Louis, Mo., at which time it was noticed that the car had been extensively damaged, that all damage had not been repaired, and that some items had been improperly repaired. An inspection of the car was made at this point by the assistant chief interchange inspector who signed a joint inspection certificate showing the defects. A defect card was not issued as the owner's recourse for the defects was against the M. & A. who damaged the car and made certain repairs. The car was moved to the owner's shop at Springfield, Mo., where an additional joint inspection was made on February 2, 1939, a copy of which was furnished the M. & A. with a request for a defect card to cover the defect. On February 8, 1939, a representative of the M. & A. inspected the car at Springfield, Mo., and agreed to issue a defect card for some of the items. The M. & A. declined to issue a defect card on the balance of the items as it felt the defects were properly repaired.

In a decision rendered November 16, 1939, the Arbitration Committee stated: "It is agreed the car was damaged in a derailment, a Rule 32 condition. The joint evidence certificate dated February 2, 1939, indicates that some of the defects were not completely repaired and also there was associated Rule 32 unrepaired damage on the body and trucks that was caused at the same time. The M. & A. claim some of these unrepaired defects were old which is an admission that they were in existence when the car was in its shop, and no claim or evidence has been presented that damage occurred subsequent thereto. The M. & A. should, therefore, issue its defect card for the damage shown in the joint inspection certificate dated February 2, 1939, except for five items on which the car owner has waived defect-card protection."—*Case No. 1774, St. Louis-San Francisco versus Missouri and Arkansas.*

Cars Damaged or Destroyed by Fire

On May 27, 1937, CYCX cars 24410 and 27055 were badly damaged by fire on the Virginia Central team track at Fredericksburg, Va. CYCX car 27055 was fully carded by the Virginia Central for defects and sent to the Norfolk, Va., shops of the Pennsylvania-Conley Tank Line where complete repairs were made. A bill for these repairs was rendered against the Virginia Central and submitted for payment in August, 1937. This bill was never paid. CYCX 24410 was sent to the General American Transportation Corporation's shops at Sharon, Pa., carrying Virginia Central defect cards for items which only covered a part of the existing damage. On August 10, 1937, a joint inspection was made for items that were not carded and the Virginia Central was requested to furnish additional defect cards covering these items. The Virginia Central refused to furnish these cards and disclaimed all responsibility for the damage involved. The Virginia Central declined to join in presenting this case before the Arbitration Committee and the Pennsylvania-Conley Tank Line presented the above facts in Ex-Parte form for a ruling as to the responsibility for the damages.

In a decision rendered November 16, 1939, the Arbitration Committee stated: "The evidence submitted indicates that these cars were damaged by explosion and fire while in the possession of the Virginia Central. Therefore, the Virginia Central is responsible."—*Ex-Parte Case No. 1775, Pennsylvania-Conley Tank Line.*

Joint Evidence for Improper Size of Side Planks Not Sustained

The St. Louis-San Francisco applied side-plank splices to Seaboard Air Line gondolas 99604 and 96801 on October 24 and October 25, 1938, respectively, at Birmingham, Ala. Later, the S. A. L. obtained joint evidence, signed by the chief interchange inspector at Birmingham, on both these cars which showed that side planks 9¾ in. instead of 10 in. wide had been applied to both of these cars, and also that the stenciling on car 96801 had been partly omitted. The S. A. L. requested the St. L.-S. F. to furnish defect card in line with A. A. R. Rule 13. A defect card was furnished for the omitted stenciling but was declined on the variation in width of the side planks. The St. L.-S. F. contended that the A. A. R. Manual of Standard and Recommended Practice, Section A, Page M-907-33-10, Paragraph 35, provides that the standard rough dry widths of car lumber from 8 to 12 in. shall not be more than ⅜ in. less than the nominal widths and, therefore, as the width of the side-plank splices was ¼ in. under the nominal width or less than the variation permitted by A. A. R. Specifications, the application of such planks does not constitute wrong repairs. The S. A. L. contended that, as both cars were designed for the purpose of carrying sand and gravel, the application of side boards with a ⅜-in. permissible variation in the widths of these boards would defeat the purpose for which they were intended.

In a decision rendered November 16, 1939, the Arbitration Committee stated: "There are no A. A. R. Standard dimensions for side planks, but, in view of the tolerances permitted in A. A. R. Lumber Specification M-907 for rough and finished lumber of these dimensions, the contention of the St. L.-S. F. is sustained."—*Case No. 1776, St. Louis-San Francisco versus Seaboard Air Line.*

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

596—*Q.—How should the piston and non-pressure head assembly be reconditioned?* A.—First, place it in a special fixture which will hold the release spring partially compressed and proceed as follows. Remove the piston rod sleeve protector, the protector ring retainer plate, the protector rings, the felt ring and its compression ring. Then remove the non-pressure head and the

release spring from the piston rod. Blow out all dirt of the non-pressure head and at the same time blow any loose dirt from the strainer. Remove and examine the strainer. If found to be in good condition, re-install it, otherwise substitute for one in good condition. Using a scraper and then the specified solvent, clean the protector ring recess in the non-pressure head, the protector rings and their retainers, the non-pressure head gasket face, and the piston and rod. If the piston is rough, smooth it with emery cloth. Using a file, break any sharp edges from the ends of the opening in the non-pressure head which guides the piston rod. Re-condition the piston rod felt ring by soaking it in a solvent to dissolve the grease and brush it to remove the surface dirt. If damaged or worn so that its spring cannot close it firmly on the rod, apply a new one after soaking it in oil. Examine the brass protector rings for wear and fit, replacing them if they do not close firmly on the rod. Examine the release spring. If rust spots are found, clean with emery cloth and coat with rust preventative.

597—*Q.—How should the piston and non-pressure head be re-assembled? A.*—After completely coating the rod with brake cylinder lubricant, place the piston and rod in the holding fixture. Then apply the spring and non-pressure head, using the locking mechanism of the fixture to hold the spring partially compressed. Place the felt ring around the piston rod in the bottom of the recess. The felt swab is held in contact with the piston rod by a circular spring wire around the outer diameter of the swab, using care to see that this spring is properly located. This may be easily accomplished by using a sleeve about 6 in. long, having an inside diameter which is a loose fit over the piston rod and an outside diameter slightly larger than the outside diameter of the felt swab. Another sleeve about 3½ in. long with an inside diameter which is a sliding fit over the long sleeve is used. The spring wire is placed over one end of the long sleeve and this end of the sleeve put over the piston rod and in contact with the felt swab. The shorter outer sleeve is then moved along the long sleeve so that the spring wire is forced off the long sleeve, this places the spring wire in its proper position around the felt swab to hold it in contact with the piston rod. Fill the protector recess about one-third full of brake cylinder lubricant. Place the metal retainer on top of the felt swab, then assemble the brass protection rings with their ends staggered. Completely fill the recess with brake cylinder lubricant, apply the retaining plate and securely lock the cap screws with lock washers.

598—*Q.—How should the packing cup be applied? A.*—It should be applied by starting the cup over one end of the piston and, while holding it in this position, work the cup into place. If the cup does not seat properly due to trapped air, the air can be removed by raising one side of the cup, using the wood tool and pushing the cup into place with the hands.

599—*Q.—If a pipe breaks off or a hose is ruptured leading to the truck brake cylinder, or brake rigging becomes defective on one truck, is it necessary to cut out the brake on that car? A.*—A cut-out cock is located in the brake cylinder pipe leading to each truck, which provides for cutting out the brake on one truck without affecting normal brake operation on the other truck.

600—*Q.—If necessary to cut out the brake on a car having control valve equipment, how is it accomplished? A.*—By closing the branch pipe cut-out cock, which is part of the combined cut-out cock and dirt collector, and holding the duplex release valve fully open until the reservoirs are drained.

601—*Q.—In the event of a "stuck brake" with the brake pipe fully charged, how may the brakes be released? A.*—By moving the handle of the duplex release valve part way to reduce the auxiliary reservoir only. When the brake starts to release, the release valve should be allowed to close in order to avoid waste of air.

602—*Q.—If the supply reservoir drain cock is open, how will the operation of the brake be effected? A.*—As the supply reservoirs are the source of brake cylinder air supply, the brake will not apply with the supply reservoirs uncharged.

603—*Q.—What is the purpose of the safety valve attached to the D-22-A control valve? A.*—To limit displacement reservoir pressure, and therefore brake cylinder pressure, during a service brake application.

604—*Q.—To what pressure does the safety valve limit displacement reservoir pressure? A.*—Between 60 and 63 lb.

605—*Q.—What is the purpose of the retaining valve? A.*—To retard the release of the brake cylinder pressure in order to provide the required time to recharge reservoirs when descending heavy grades.

* * *

Cleanliness is highly stressed at the Galesburg steel car shop of the C. B. & Q. where this tractor and side-dump trailer offer a convenient means of transporting refuse and dirt up the inclined runway for easy loading on the dirt car

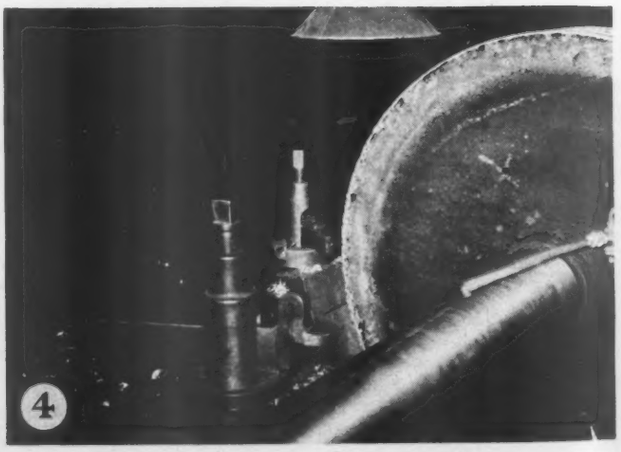
Performance of

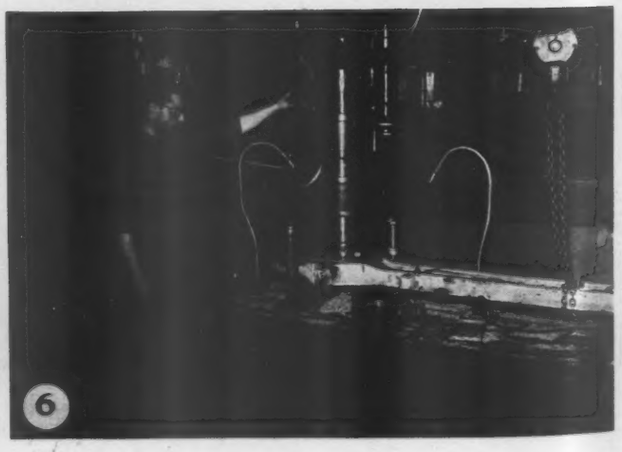
Carboloy on Railroad Work

THE 11 photographs on this and the opposite page show the various set ups for a variety of locomotive and wheel machining operations in the Battle Creek, Mich., shops of the Grand Trunk Western where Carboloy has been introduced and tested on these jobs over a period of many months. In the table on the opposite page is given the important data in connection with the operations which are shown in the photographs. All of the jobs listed in the table are illustrated with the exception of the rod knuckle pin and the trailer axle operations, which are listed as Job No. 7 and Job No. 9 in the table.

A most important consideration in the use of Carboloy tools is that they be properly ground for the job and in this particular shop a grinder such as that shown in Photo No. 11 is used on these tools. This particular tool grinder is an Excello 6-in. machine using a silicon-carbide 80-R wheel for finishing. Rough grinding is done on a floor grinder using a 12-in. 60-R silicon-carbide wheel. For grinding the cutting tool bits used in

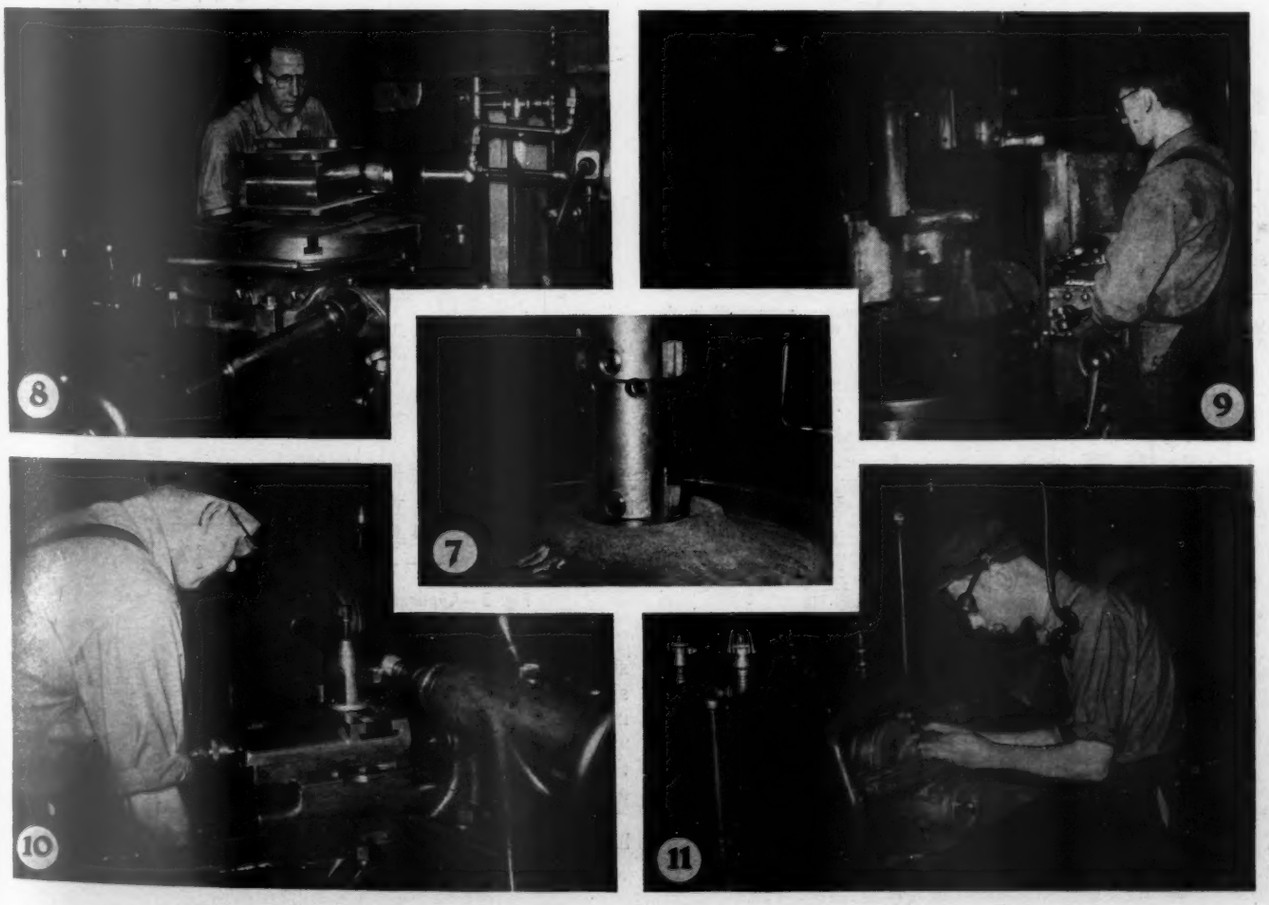
(*Text continued on page* 370)





Operation Data for Carboloy Tools on Railroad Machining Work

Job No.	Name of Part	Material	Operation	Machine	Cutting speed, f.p.m. Rough	Cutting speed, f.p.m. Fin.	Feed, in. Rough	Feed, in. Fin.	Depth of cut, in. Rough	Depth of cut, in. Fin.	Floor-to-floor time Carboloy hr.	Floor-to-floor time Carboloy min.	Floor-to-floor time Former tools hr.	Floor-to-floor time Former tools min.	Remarks
1	Driving box floating bushing (Photo. No. 1)	Bronze bearing metal	Bore, turn and face	42-in. Bullard vertical turret lathe	228	228	.033	.015	.313	.032	1	0	2	0	Tool ground every 90 days; touched up with hand-stone occasionally
2	Driving wheel hub liner (Photo. No. 2)	Bronze bearing metal	Face, bore and turn	Bullard vertical turret lathe	460	460	.020	.020	.188	.032	0	20	0	30	Intermittent cut; tools machine-ground every 90 days; touched up with hand-stone occasionally
3	44-in. driving wheel tires (Photo. No. 3)	Steel, 45 Rockwell, C scale	Finish-bore	Betts-Newton vertical boring mill	...	216	...	.015	...	.035	0	35	0	60	32 pieces per grind; held to .001-in. limit
4	Piston head (Photo. No. 4)	Hunt-Spiller gun iron	Finish-turn	Engine lathe	...	265	...	.062	...	.062	0	15	0	20	.....
5	Side rod bushing (Photo. No. 5)	Bearing bronze	Turn, bore, face chamfer and cut off	32-in. Gisholt vertical boring mill	350	350	.062	.062	.188	.031	0	15	0	30	Tools used on variety of jobs; ground every three weeks
6	Solid side rod bearing (Photo. No. 6)	Bearing bronze	Finish bore and recess	Newton vertical rod borer	...	400	...	.031	...	.062	4 (For eight bushings)	30	8	0	Four weeks between tool grinding; jigs also helped reduce time
7	Rod knuckle pin (not shown)	Steel, 18 Rockwell, B scale	Finish-turn taper, face ends and turn body	.....	...	170	...	.015	...	varies	0	45	1	30	.....
8	Freight car wheel (Photo. No. 7)	Cast iron	Bore	52-in. Betts vertical hydraulic boring mill	90	...	.125	...	.250	...	0	5	0	5	Carboloy-400 pieces per tool grind; longer tool life justifies use of Carboloy
9	Trailer axle (Not shown)	Steel, 18 Rockwell, B scale	Finish-turn for grinding	Engine lathe	...	433	...	.007	...	.125	1	0	2	0	Five pieces per tool grind
10	Driving box bearing (Photo. No. 9)	Bearing bronze	Rough and finish bore bearing and face hub liner	42-in. Bullard vertical turret lathe	350	350	.031	.031	.375	.031	0	10	0	30	Intermittent cut; tool operates 90 days between grinds; touched up by hand occasionally
11	Main rod brasses (Photo No. 8)	Bronze	Mill sides and ends	Cincinnati No. 5 milling machine	...	500	...	15 in. per min.	...	.250	1	30	3	0	Pieces per tool grind—15
12	Pump piston rods (Photo No. 10)	Stainless steel—metal sprayed	Finish-turn after spray-spraying	Engine lathe	...	242	...	.005	...	.016	0	20	See note		Note: Pieces per grind—12; formerly had to be ground from the rough.



the Davis boring bar on cast iron car wheel work a Wilmarth & Morman grinder is used with a 6-in. 60-R silicon-carbide wheel for roughing and a 6-in. diamond wheel for finishing.

Particular attention is called to the time savings effected on these jobs; to the number of pieces that can be machined on some of the more difficult work and to the machining jobs on which the tools are ground at three- and four-month periods.

Ash Pan Hopper Castings

A boiler foreman recently developed an idea which has turned out to be a money saver. As every shop man knows, the bottom of an ash pan hopper is so planned as to accommodate a slide. This slide has a flange that slides in the groove of the casting. The usual thing to do when this groove wears out—which is often due to the abrasion of the ashes and cinders—is to throw the casting away. The idea of throwing all these good castings away led to the development of this method: a scrap casting was put on a planer and the worn part of the groove planed away, that is the bottom part, then the casting was drilled and tapped for five equally-spaced 7/8-in. studs. Next, a bar of iron about 5/8 in. by 2 in. was drilled to drop down over the studs. When this was tightened into place it made a perfect groove for the slide and whenever this slide wears out it is but a few minutes job to replace it with a new bar, as they are all drilled to a standard. On this road this method is now standard practice on all such castings when they are purchased new.

Improved Method of Applying Boiler Patches*

The old and new methods of applying boiler patches on one railroad are shown in the accompanying illustrations. The patches applied by the new method have proved satisfactory in service and have reduced the labor required for their application. Fig. 1 shows the old method used in the application of throat-sheet or knuckle patches. This method required considerable labor for scarfing the sheets, and the heating and raising of the old sheets. It resulted in the reduction of the efficiency of the patch.

Fig. 2 illustrates the new method of applying a boiler patch similar to the one shown in Fig. 1. A taper filler is built up by electric welding from the original thickness of the boiler sheet down to zero. This wedge is about 2½ in. wide and extends ¼ in. above and below the edge of the patch. This method makes it unnecessary to scarf the patch or to heat and raise the old sheets. Full efficiency is obtained as the entire thickness of the patch is retained. The patch is easy to apply as all the heating and laying up is performed from the outside which results in a reduction of the amount of labor required in the application.

Fig. 3 shows the manner of applying a patch to the back head. The defect was a crack in the outside radius.

(*Continued on next left-hand page*)

* An entry in the prize competition on boiler patches, announced in the March, 1939, issue. The names of the winners were published in the August, 1939, issue.

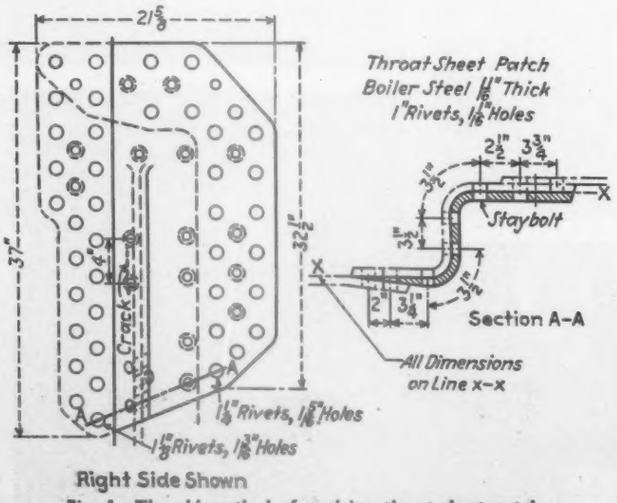


Fig. 1—The old method of applying throat-sheet patch

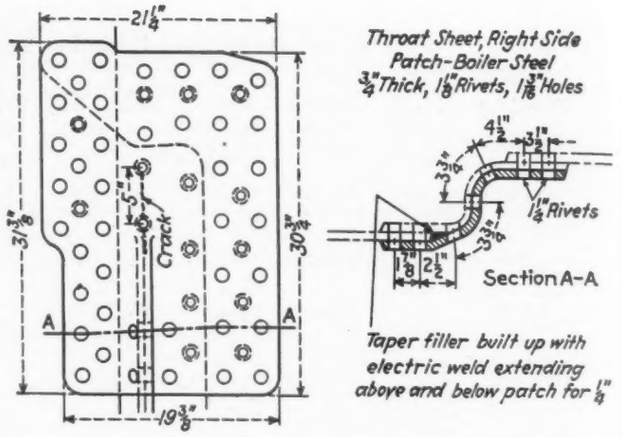

Throat Sheet, Right Side
Patch-Boiler Steel
3/4" Thick, 1 1/8" Rivets, 1 3/16" Holes
1/4" Rivets
Section A-A
Crack
Taper filler built up with electric weld extending above and below patch for 1/4"

Fig. 2—The new method of applying throat-sheet patch

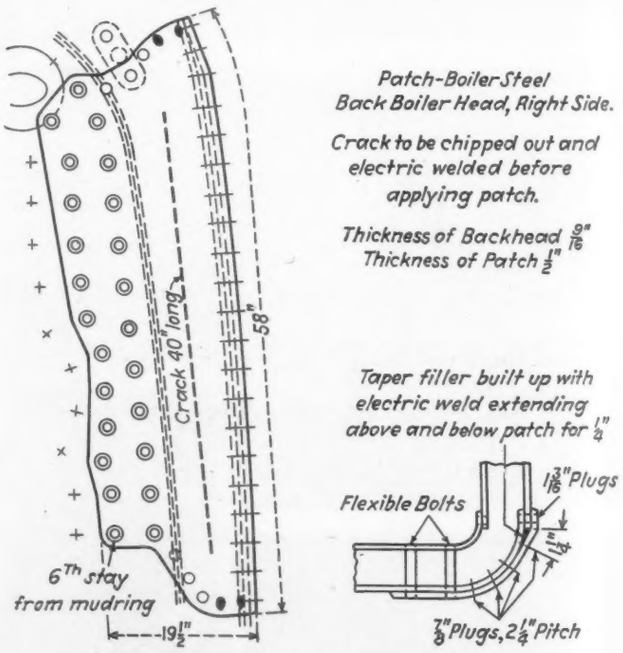
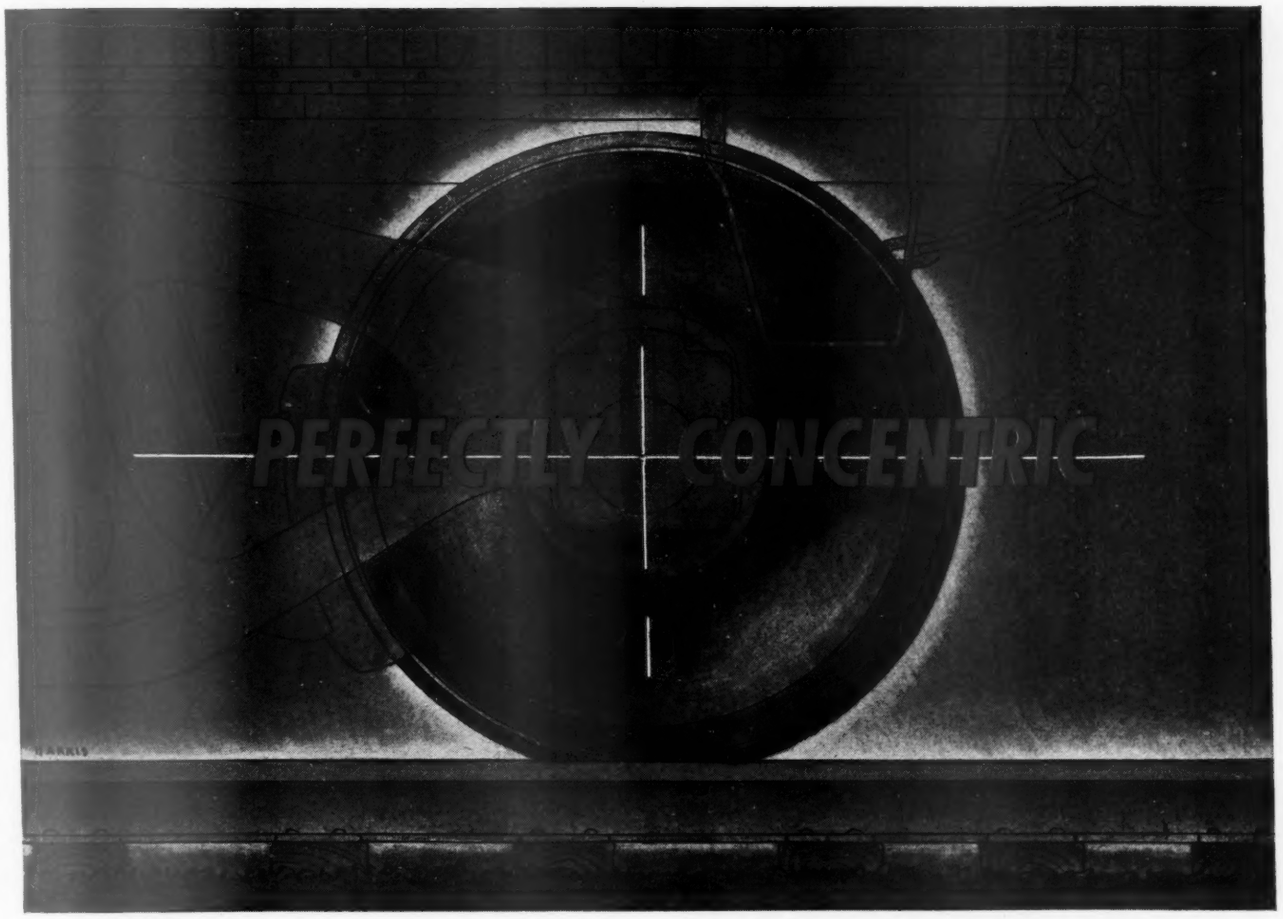

Patch-Boiler Steel
Back Boiler Head, Right Side.
Crack to be chipped out and electric welded before applying patch.
Thickness of Backhead 9/16"
Thickness of Patch 1/2"
Crack 40" long
58"
6th stay from mudring
Taper filler built up with electric weld extending above and below patch for 1/4"
Flexible Bolts
1 3/16" Plugs
7/8" Plugs, 2 1/4" Pitch

Fig. 3—Application of a patch to the back head



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The chilled iron wheel, therefore, requires no machining of the tread after it has been placed in service. Once properly mounted it remains, perfectly concentric for life.

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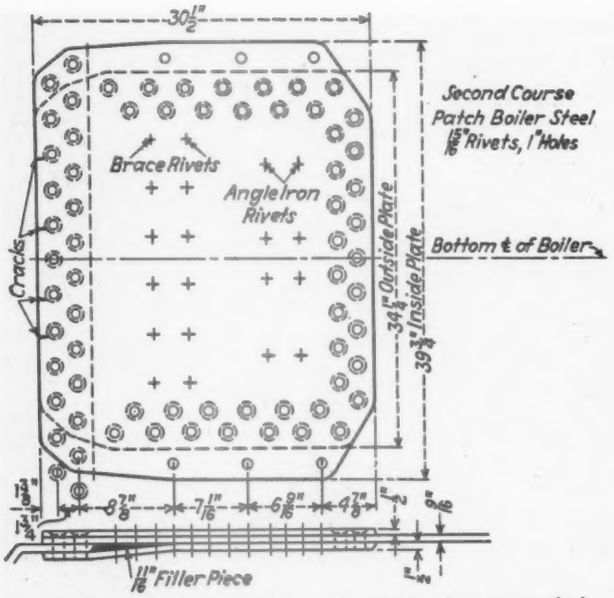


Fig. 4—Application of a patch on the shell by the same method

The crack was chipped out and welded before the patch was applied. Again, a taper filler is built up by electric welding similar to the one shown in Fig. 2, which eliminates scarfing and the heating and raising of the wrapper sheet. The old method of applying this patch frequently resulted in the breaking or cracking of the sheets at the rivet holes.

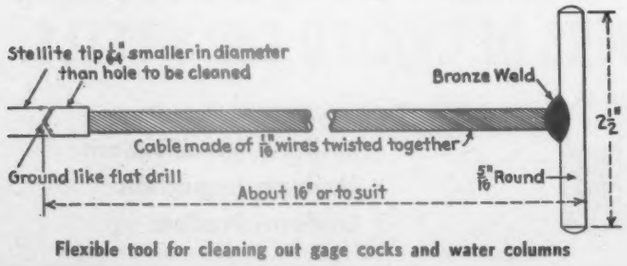
The former method of applying patches similar to the one shown in Fig. 4 consisted of planing or scarfing the end of the patch, heating and opening up the circumferential seams and inserting the patch and then heating and laying up the circumferential seams. The present method of applying this form of patch is shown in Fig. 4. A wedge to be used as a filler piece is machined with a width of approximately 10 in. and of sufficient length to extend ¼ in. above and below the patch. The wedge is applied to the edge of the boiler course and seal welded for about two inches at both ends. This method eliminates the cracking at the rivet holes in the boiler shell which occurred when the sheets were opened up for application of the patch by the old method.

Clean-Out Tool For Water Columns

By Arthur Havens

It had been customary in the enginehouse to clean water columns and gage cocks, at the monthly wash out period, by running a wire into the fittings to make sure these passages were not blocked with scale or sediment. This practice was prohibited and it became necessary to drill these openings, at each wash-out, to the original size of the opening. This sounds simple but when the difficulties are taken into consideration the job takes on an entirely different aspect. These passages seldom line up all the way through, thus making it impossible to use an ordinary straight drill; then there are always a million or less pipes and parts in the way adding to the trouble of getting a rigid tool of any kind through all of these openings. A simple solution to this job is the tool shown in the drawing.

It is made as follows: Cut a number of wires about 1/16 in. diameter and about five feet long. Bend them in the middle and hang them on a steel rod ½ in. by 24 in. The ends of the wires—enough of them when twisted to equal a diameter just under the size drill required—are then grouped and caught in a vise. While held in this manner the steel rod is gripped in both hands and turned end for end until the wires resemble a steel cable. A section long enough to serve the purpose is then cut from this home-made flexible shaft. The next step is to coat and build up one end of the cable with Stellite. The Stellite is ground to the proper width and sharpened like a flat drill. A short piece of round stock is welded to the other end of the shaft or if one prefers a steel ring may be used. This tool will follow almost any irregular hole. The handle can be bent to avoid pipes and other bothersome parts in the cab and it is obvious that these drills can be made in any size desired with very little effort.

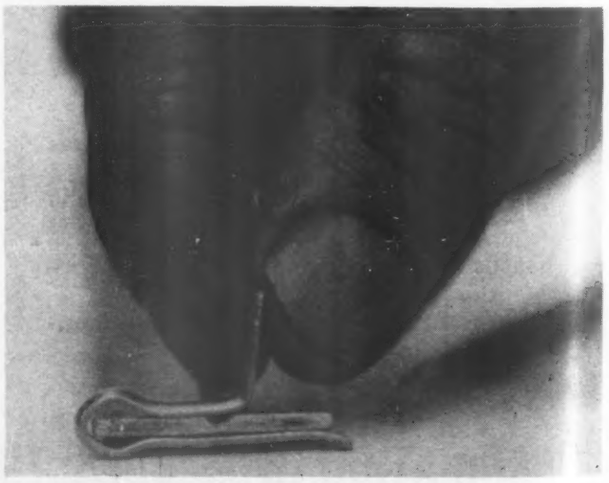

Stellite tip 1/64" smaller in diameter
than hole to be cleaned
Bronze Weld
Cable made of 1/16" wires twisted together
Ground like flat drill
5/16" Round
About 16" or to suit
2½"

Flexible tool for cleaning out gage cocks and water columns

Spring Cotter Makes Handy Scale Grip

By Frank Bentley

The illustration shows the use of a spring cotter to make a handy finger grip for lifting and moving scales and straight edges over whiting as usually applied to various metal parts preliminary to layout work. Thin flat scales



Use of a spring clip as a handy finger grip for scales

and straight edges, when used on layout whiting, are somewhat difficult to handle. The finger ends, when picking them up or shifting to other positions, often mark and smudge the whiting. Take two spring cotters

(*Continued on next left-hand page*)

SPEED

Photo courtesy Southern Pacific Company

. . . is the essence of the times

The tempo of industry has speeded up. Confronted with the unexpected demands, the railroads are preparing to participate in the defense program by keeping supplies and materials moving . . . . and moving rapidly.

To do this the more progressive railroads are ordering new Lima Super Power . . . . power capable of handling the increased loads quickly and economically.

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and fit one to each end of the scale as shown. Bend them open so they will snugly and squarely fit the flat width of the scale. Bend half of one part straight up. This makes an excellent finger grip to pick up and move the edge. Bend the end of the other half down and point with a file. The scale or edge is not too far away from the surface for marking with the scribing point, and it will not slip when held or pressed down with the finger ends. Only two small metal points touch the whited surface which keeps it clean with only the lines, circles and other layout marks clear and plain for machining.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

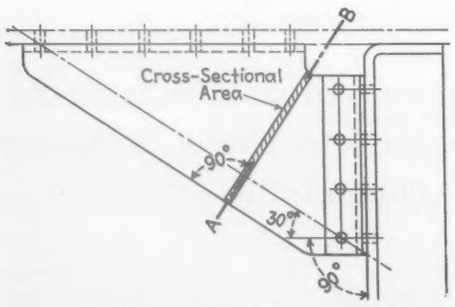
Determining Cross-Sectional Area of Gusset Brace

Q.—How is the cross-sectional area of a gusset brace for the front tube sheet of a locomotive boiler determined?—M. E. D.

A.—Gusset stays constructed of triangular right-angle plates secured to the tube sheet and shell with double angle irons, or to the tube sheet with double angle irons and flanged over at the top for connection to the shell, shall have a cross-sectional area (in a plane at right angles to the longest side and passing through the intersection of the two short sides) equal to the cross-sectional area that would be required for a diagonal stay to support the same surface.

The line representing the angle of the brace shall be a line intersecting the front rivet in the flange where riveted to the wrapper sheet and the bottom bolt in the backhead angle irons where the gusset plate fastens to the angle iron.

As an example the required cross-sectional area of the gusset shown in the diagram to support 200 sq. in.



Gusset brace for the front tube sheet

of front tube-sheet area under a working pressure of 250 lb. per sq. in. is determined as follows:

$250 \times 200 = 50{,}000$ lb. = load supported by brace

The maximum allowable stress per square inch of net cross-sectional area on round, rectangular, or gusset braces is 9,000 lb.—I.C.C. rule.

$50{,}000 \div 9{,}000 = 5.55$ sq. in. = required cross-sectional area of straight brace rod

In calculating stresses on braces and their attachments, the angularity of the brace, if in excess of 15 deg. must be taken into consideration. The required cross-sectional area of the brace is divided by the cosine of the angle that the brace makes with a line drawn at right angles to the area supported. This angle is 30 deg. as shown.

Cosine 30 deg. = .8660

$5.55 \div .866 = 6.4$ sq. in. = required cross-sectional area of brace taken along line *A-B*

The A.S.M.E. Code states that the cross-sectional area of gusset stays shall be 10 per cent greater than would be required for a diagonal stay to support the same surface.

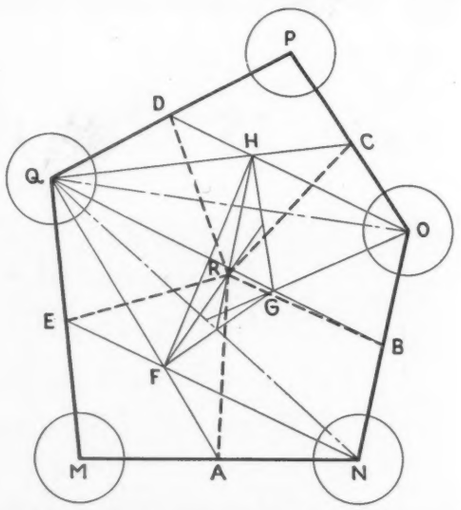
Area Supported By Unequally-Spaced Staybolts

Q.—When staybolts are unequally spaced, causing an irregular area to be supported, how is the area proportioned as to the load on each staybolt surrounding it? What is taken as the pitch of the staybolts for such an area?—F. E. C.

A.—A practical method of determining the area supported by each staybolt is illustrated in the diagram.

Area *M, N, O, P, Q* is supported by the staybolts *M, N, O, P, Q*. First, obtain the center of gravity of the area *M, N, O, P, Q* as follows:

Bisect the distances *O-P* and *P-Q* locating the points *C* and *D*. Connect *C-Q* and *O-D* with lines intersecting at *H* which is the center of gravity of the triangle *O-P-Q*. In the same manner locate the center of gravity of the triangles *N-O-Q* as *G* and *Q-N-M* as *F*.



A graphical method for determining the area supported by unequally-spaced staybolts

In the same manner obtain the center of gravity of the triangle *F-G-H* as *R*. *R* will also be the center of gravity of the area *M, N, O, P, Q*.

Bisect the distance *M-N* locating the point *A*, bisect the distance *O-N*, locating the point *B* and in like manner the point *E*.

Connect the points *R-A, R-B, R-C, R-D* and *R-E* with dotted lines. The area *M-A-R-E* will be supported by

(Continued on next left-hand page)

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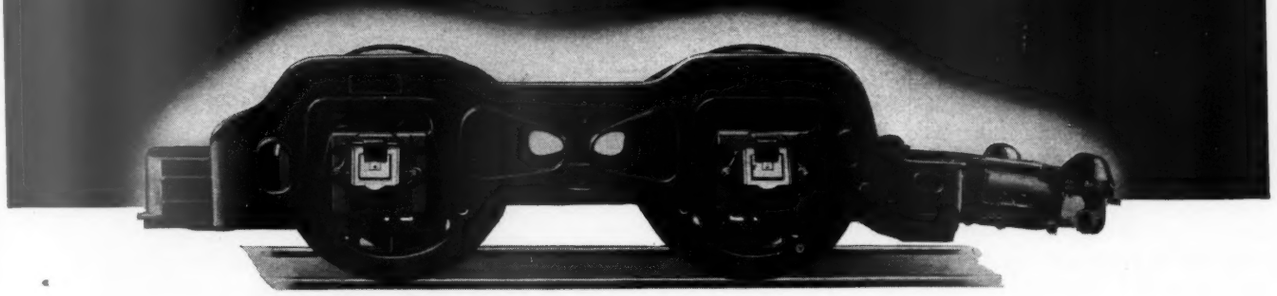

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staybolt *M*, the area *E-R-D-Q* will be supported by the staybolt *Q*, and in like manner obtain the proportional area supported by each staybolt.

In cases where the staybolting of boiler plates is unsymmetrical for reason of interference with butt straps or other construction, it is the opinion of the A. S. M. E. Boiler Code Committee that in addition to the special provisions of Pars. P-205 and P-207, it is permissible to consider the load carried by each staybolt as the area calculated by taking the distance from the center of the spacing on one side of the bolt to the center of the spacing on the other side.

Tolerance Used in Fitting Shell Courses

Q.—When fabricating cylindrical courses, what tolerance should be allowed for fitting courses together at the circumferential seams?—F. E. D.

A.—The A. S. M. E. Code states that the inside circumference of an outside course shall not exceed the outside circumference of the inside course or head by more than ¼ in., the circumference to be measured before being bolted together. The space between the edges of the ends of the plate when rolled and bolted together for butt-strap riveting shall not exceed ¼ in.

Locomotive practice in developing boiler shell courses is to lay out the circumference of the inside and outside courses to the nearest 1/16 in. based on the neutral diameters of the courses. No allowance is made. When assembling the rings, the end of the largest ring is heated and expanded enough to allow the smaller course to slip in up to the width of the circumferential seam. Shell courses are fitted with a metal to metal contact, thus eliminating the possibility of stresses being set up in the plates when they are riveted together.

Holding and Welding Firebox Sheets

Q.—In welding fireboxes we have considerable trouble holding the plates in line; that is, the opening between the sheets tends to increase as the welding proceeds. What causes this condition and can it be overcome?—R. F. D.

A.—When two plates with an opening between them are welded with bare or washed electrode, the plates will draw together as the welding progresses. The amount will depend upon the welding speed. As a rule, the greater the speed, the less is the amount of the drawing effect. There can be found a speed at which the plates will not draw together. If the welding speed is further increased as when using shielded-arc electrodes, the plates will separate while welding proceeds. In the latter case, it will be necessary to tack or clamp the ends together before beginning the welding. This condition is due to the expansion and contraction in the plate caused by the welding heat.

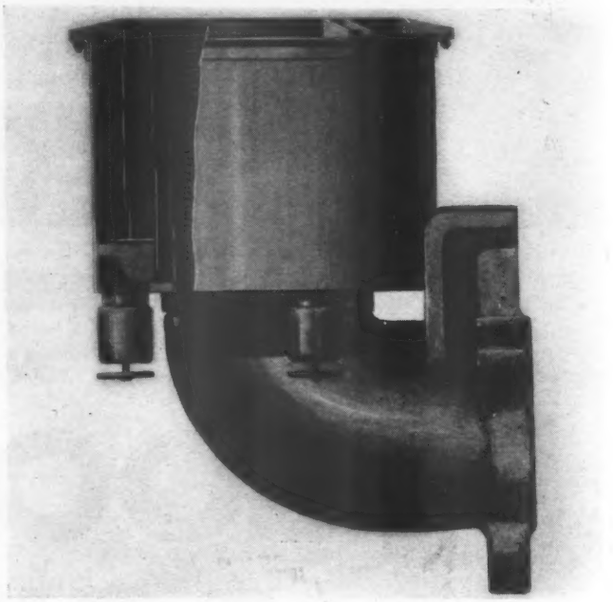
In butt welding firebox sheets, the sheets should be beveled on the fire side and, wherever possible, the weld be reinforced on the opposite side of the bevel. In preparing firebox sheets for welding, an opening of from 1/8 in. to 3/16 in. should be allowed between the sheets to obtain the full penetration of the weld. Where the shielded-arc electrodes are used, closer fitting is necessary and an opening of 1/16 in. between sheets is sufficient. The bevel should not be less than 30 deg.

After clamping the sheets in place, they should be tacked at sufficiently close intervals to hold them properly in place while welding. All necessary tacking should be done before welding is started, to prevent the sheets from being drawn out of line and also to hold a uniform opening for proper penetration.

Improved Steam Dryer

The Dri-Steam Valve Sales Corp., New York, has introduced new improvements in its standard line of locomotive steam driers. The latest design of dryer is shown in the illustration with a cut-away section showing the details of construction.

This dryer has a steel shell that surrounds three concentric cylindrical shells and between these four shells at the bottom are three annular collecting chambers. All of these collecting chambers open into a common annular receiving chamber at the bottom between the two outer shells. Referring to the three inside cylindrical shells, the outermost has continuous bands of slots or louvers inclined 30 deg. to the right of the vertical, while those in the next inside shell are inclined 30 deg. to the left. The innermost shell is pierced by thousands of small diverging nozzles which protrude from its outer surface. The bottom of the innermost cylinder opens into the standpipe. Except for the outside annular chamber all of the openings at the top are closed by a cover plate.



The improved Dri-Steam locomotive steam dryer with section cut-away to show its construction

In operation, steam from the top of the steam dome enters vertically through the outside annular opening and passes in thin streams through the louvers in the first inside cylinder into the middle collecting chamber. The inclination of the louvers produces a continuous downward helical thrust in a counter-clockwise direction to the steam flow. This action forces the separated water to the bottom as the steam reverses sharply to enter the oppositely inclined louvers in the next inside cylinder where the foregoing action is repeated in a clockwise direction in the inner collecting chamber. Here the rapidly whirling steam scrubs across the protruding nozzle tips before combing through the nozzle openings into the interior of the inside cylinder and then entering the standpipe. Check valves are applied to the receiving chamber and permit the free drainage of the water into the boiler, but close instantly to prevent backflow, should syphoning occur.

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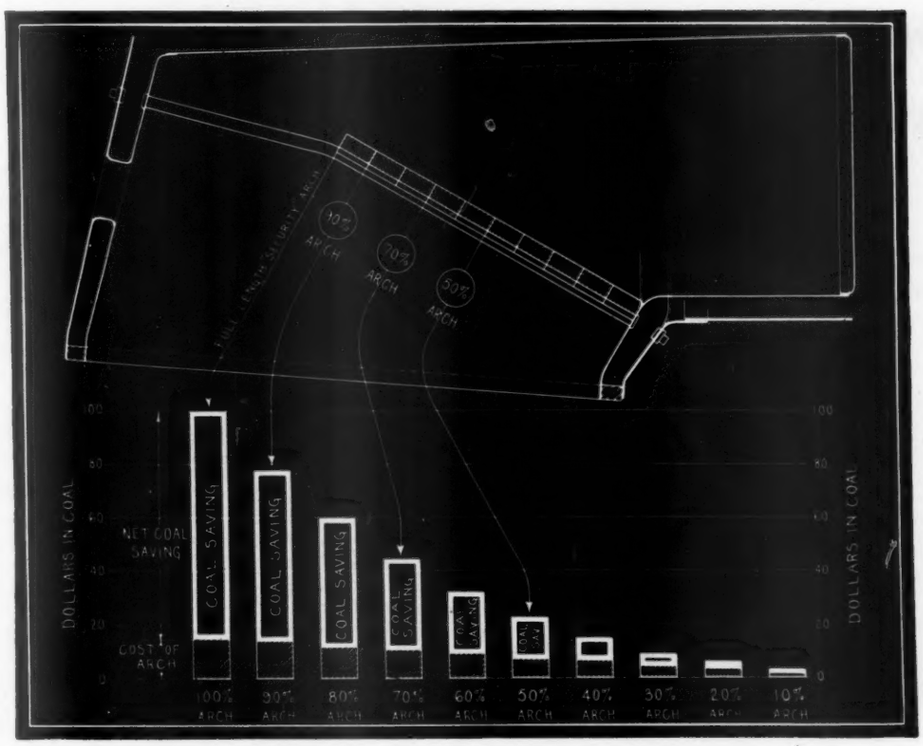

THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

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With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

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Railway Affairs . . .

Willkie Notification Taxes Railroad Facilities

Elwood, a small town of 12,000 inhabitants, in a farming district of Indiana, was the center of interest in this country and much of the world, also, when on August 17 Wendell Willkie was formally notified of his nomination for the Presidency. It is about 160 miles from Chicago and is served by single-track lines of the Pennsylvania and the Nickel Plate. Naturally it proved to be a real problem for the railroads to adjust their facilities to meet the emergency. This was not simplified by the fact that much passenger equipment was still assigned to handling of troops to the summer maneuver camps. Thirty-five trains brought more than 20,000 people to the town within a period of about five hours. Of the 29 trains handled by the Pennsylvania, 15 came from the North and 14 from the East. It required some ingenuity to unload these trains on a single-track line, store 330 cars and 29 locomotives and service them, and then, after the ceremony, to spot, reload and dispatch the trains on a 10-minute headway. The Nickel Plate had a somewhat easier task in handling its six special trains, three from the East and three from the West. Many special facilities had to be installed by both roads and a considerable number of employees had to be brought in for the occasion.

"Coach-Sleepers" Stimulate Business

The Pullman Company has been experimenting with two experimental coach-sleepers on the North Coast Limited of the C. B. & Q.—N. P. and the Empire Builder of the C. B. & Q.—G. N. between Chicago and Seattle, Wash. These have an aisle down one side of the car with ten compartments, five of them to seat and sleep three persons each and five arranged to accommodate six persons each. The berths are arranged in three tiers and during the daytime disappearing partitions between the compartments add to the spaciousness. So successful have these cars proven that two additional ones are being made. The charge for the service between Chicago and Seattle is $5 for the accommodation, the rail ticket costing $39.50. Questionnaires from the first 496 passengers carried disclosed that in the absence of these sleepers 33.5 per cent of the passengers would have used tourist cars, 10.1 per cent standard Pullmans, 38.3 per cent a railroad coach, 9.5 per cent, bus; 6.8 per cent automobile; 0.6 per cent, airplane, and 1.2 per cent would not have made the trip. Most of the passengers were vacation travelers, but 16.4 per cent were commercial, 5.6 per cent migratory, and 3.1 per cent emergency. The great majority found the service satisfactory, only 3.7 per cent reporting unfavorably.

Railroad Brotherhoods Oppose Draft Bill

The five railway operating brotherhoods have taken a strong stand against the Burke-Wadsworth Military Training Bill. A letter signed by their presidents concludes with this statement: "These organizations are wholeheartedly in accord with the establishment and maintenance of an adequate national defense, and their membership will not be found wanting in any support of such proper measures, but we are convinced that under present conditions the regimenting of our people according to the contemplated military pattern is unnecessary and is an infringement upon the civil liberties which they may reasonably expect to enjoy." A preceding paragraph, which enumerates the reasons for this decision, reads as follows: "Compulsory military service in time of peace is the very antithesis of freedom. It involves an infringement of the very principles of democracy which it is invoked to defend. It imposes upon the individual a mandate to give service which he may not be in position to render without serious sacrifices on the part of himself or his family, or both, and this at a time when there are thousands of other individuals who would be glad to avail themselves of the opportunity to serve if such opportunity were not denied by the restrictive rules observed by the recruiting service."

S. 2009

The Wheeler-Lea omnibus transportation bill S. 2009 has again come to life. Congress, held in session during the summer months because of the national defense program, apparently found time in its spare moments to give it consideration. Quite probably, also, the leaders of the transportation brotherhoods, who sabotaged it and forced it back into conference, helped to bring it out of that committee when they found what the boys back home thought of their shortsighted action. At any rate, it passed the House on August 12 by a vote of 246 to 74, with compromise "labor-protection" provisions and a modified Jones agricultural rate amendment. Senator Wheeler, chairman of the Senate Committee on Interstate Commerce, has indicated that he will call it up in that body when the debate on the conscription bill is concluded. If past declarations of the President about his concern for the railroads mean anything, he should sign the bill, but after his curious reversal in form in vetoing the "bridge bill", it is unsafe to hazard any prediction as to what course he will follow. The amended bill, as it now stands, will be some improvement over legislation now on the books, but as the Railway Age points out, it will give the carriers, at most, only about 40 per cent of what they asked for.

Army Maneuvers Make Heavy Demands on Railroads

The Army maneuvers in this country in August required intensive use of railroad facilities at a time when the vacation tourist business was at its height. In three of the heaviest troop movement days, August 4, 5 and 6, the railroads moved nearly one-sixth as many men as were transported during the entire 31 days of the heaviest month's movement during the World War. From July 30 to August 12, the railroads moved 150,000 troops of the regular Army and National Guard and their equipment from all parts of the country to the four Army Areas. In spite of bad weather conditions in some sections, the trains were moved close to schedule. Army authorities were said to be pleased with the results. The Quartermaster General's office is also said to have pointed out that it is highly improbable that the railroads will be called upon, even in war time, to handle more troops in a similar period than were transported during the peak days of the August movement.

Mexican Railway Employees Don't Like to Economize

President Cardenas of Mexico in June instructed the union officers and the Workers Administration of the National Railways of Mexico to reorganize the service, including certain freight rates, and to reduce operating expenses. He also stressed the importance of resuming payment of obligations with American firms that had been held in abeyance since February. The board recommended changes which would effect a saving of 1,800,000 pesos a month. These measures included among other things, a reduction in salaries to what they were on May 1, 1938, suppression of unnecessary posts, that personnel be compelled to dispose of vacations in time instead of receiving its equivalent in cash, that a maximum of motive power be utilized by completing train loads, the reestablishment of a most rigid disciplinary regime and that authority be reinstated to heads of departments to apply discipline. The Union of Mexican Railway Workers objected to these changes and as a result of the controversy General Manager Juan Gutierrez and the Board of Workers Administration have been forced to resign.

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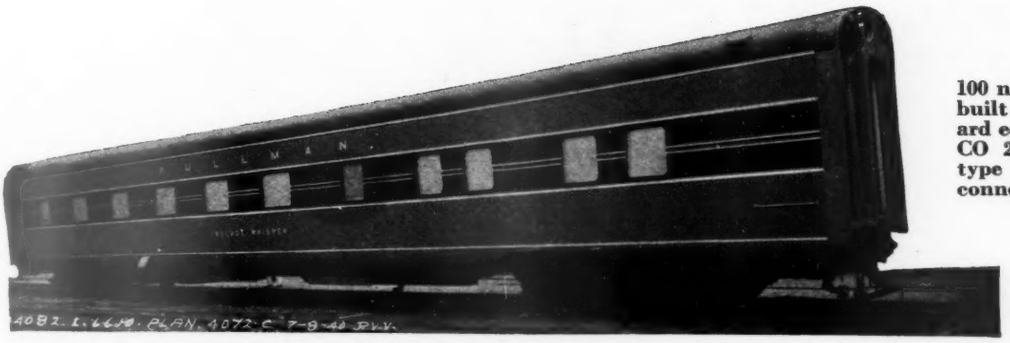

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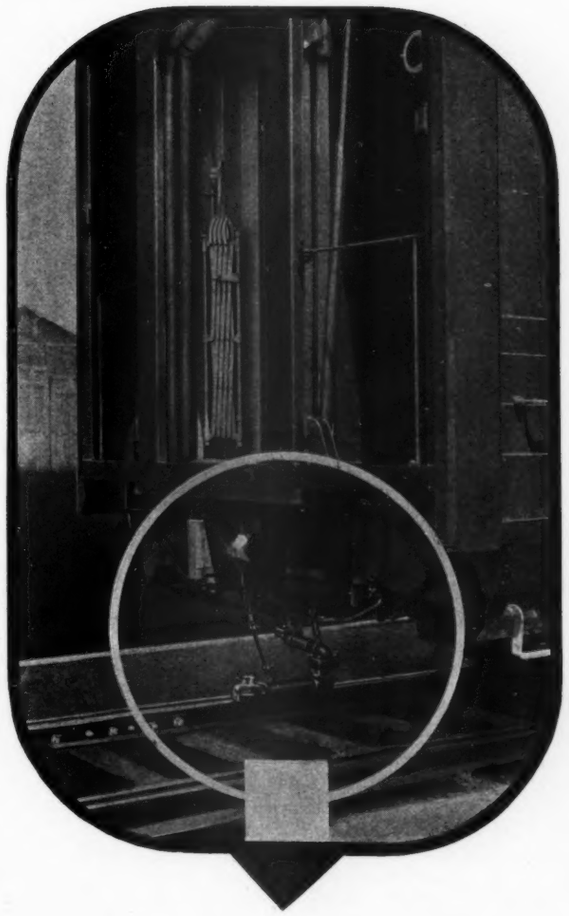

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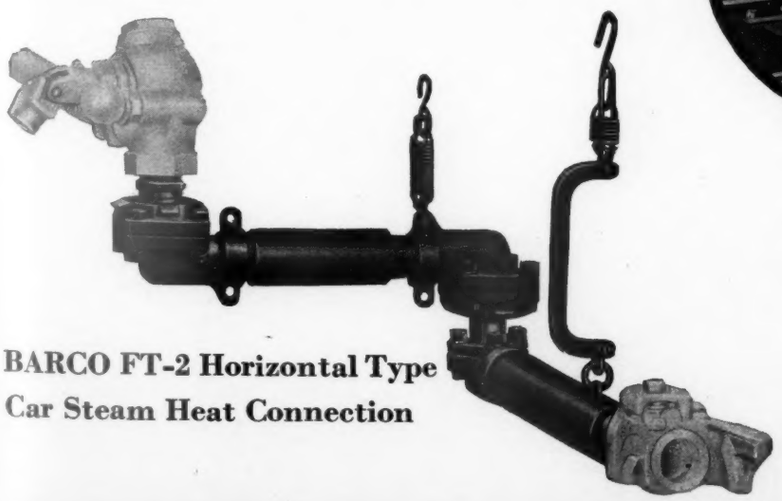

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NEWS

Two New Members Join A. A. R.

THE Wheeling & Lake Erie and the Pittsburgh & West Virginia have become members of the Association of American Railroads, according to an announcement by that organization on August 16.

172 Experimental Tank Cars for A. c. f.

THE American Car and Foundry Company has been granted authority by the Interstate Commerce Commission to construct for experimental service in the transportation of caustic soda solution and petroleum products a total of 172 tank-car tanks fabricated by the fusion welding process.

Equipment Purchasing and Construction

The Chicago, Burlington & Quincy.—The Burlington will shortly begin the construction of 1,000 single sheathed 50-ton box cars in their own shops.

A contract has been awarded the Karnoff Construction Company, Kansas City, Mo., by the C. B. & Q. for the construction of a brick and concrete enginehouse at North Kansas City, Mo.

Company forces of the C. B. & Q. are making improvements at the enginehouse and local switching yards in Ottumwa, Iowa, to expedite the servicing of locomotives and movement of fast trains. Yard trackage is being improved and cinder, sand and coal facilities rearranged so that eastbound locomotives can take coal, water and sand and drop cinders at one spotting.

The Chicago, Milwaukee, St. Paul & Pacific.—The Milwaukee is completing the construction of 2,000 50-ton box cars and 25 caboose cars in their own shops.

The Chicago, Rock Island & Pacific.—The Rock Island has been authorized by the district court to purchase 800 box cars, 200 automobile cars and 100 gondola cars at an approximate cost of $3,090,000, and to rebuild 300 flat cars and remodel 100 coal cars in the company's shops at an estimated cost of $263,000.

Mobile & Ohio.—The M. & O. has asked the Interstate Commerce Commission for authority to assume liability for $2,700,000 of 2½ per cent equipment trust certificates, maturing in 15 equal annual installments of $180,000 on August 1 from 1941 to 1955, inclusive. The proceeds will be used as part payment for equipment costing a total of $3,399,000, and consisting of 1,000 40-ton, 40 ft. 6 in. box cars; 250 50-ton, 33 ft. one-fourth in. self-clearing hopper cars; and two 2,000 hp. Diesel-electric locomotives.

The petition states that the company will sell to the car builders 2,000 reconditioned and rebuilt trucks and 1,000 rebuilt axles, costing $472,500, which, together with $226,500 in cash, will constitute the difference between the proceeds of the certificates and the total cost of the equipment. The issue has been sold at 100.099 to Salomon Brothers & Hutzler.

Army and Navy Do Much Buying Locally

THE War and Navy Departments have issued a public statement that current information concerning national defense purchases can best be secured from the field offices which the departments have established throughout the country rather than by writing to Washington, D. C., or by sending representatives to the capital. The Navy Department maintains 27 major field purchasing offices in 23 cities, while the War Department has 46 major field procurement offices in 22 cities.

For the information of manufacturers, the Department of Commerce has issued a 16-page booklet giving information concerning these offices. Partial lists of materials being purchased by various agencies of the War and Navy departments appear therein, together with the special field procurement and purchasing offices which have been established. Of particular interest to railroad supply companies will be those offices set up by the Engineers Corps of the Army which is interested, among other things, in air-brake equipment, railroad cars, air compressors, gasoline and steam engines, electric motors and gasoline and steam locomotives.

Orders and Inquiries for New Equipment Placed Since the Closing of the August Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Locos.	Builder
Akron, Canton & Youngstown	2	2-8-2	Lima Loco. Wks.
Atlantic Coast Line	18	2,000-hp. Diesel-elec.	Electro-Motive Corp.
Southern Pacific	20	4-8-4	Lima Loco. Wks.
Chicago & North Western, Union Pacific, Southern Pacific	1[1]	Diesel-elec	Electro-Motive Corp.
Chicago & North Western, Union Pacific	1[1]	Diesel-elec	Electro-Motive Corp.

LOCOMOTIVE INQUIRIES

Chesapeake & Ohio	10	2-6-6-6	.....
Duluth, Missabe & Iron Range	8	Locos.	.....

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Charleston & Western Carolina	35	50-ton hoppers	Pull.-Std. Car Mfg. Co.
Chicago & North Western	60[2]	70-ton hoppers	Gen. Amer. Transp. Corp.
Chicago, Indianapolis & Louisville	100	50-ton hoppers	Pull.-Std. Car Mfg. Co.
Louisville & Nashville	100	Box	Pull.-Std. Car Mfg. Co.
	100	Automobile	Pull.-Std. Car Mfg. Co.
Norfolk & Western	500	Box	Ralston Steel Car Co.
Southern Pacific	500	Box	Gen. Amer. Transp. Corp.
	500	Box	Pressed Steel Car Co.
	500	Box	Bethlehem Steel Co.
	500	Automobile	Mt. Vernon Car Mfg. Co.
	350	Hopper	American Car & Fdry. Co.
	125	Flat	Company Shops
	15	70-ton gondolas	Company Shops
	50	Cabooses	Company Shops
Union Pacific	100	70-ton cement	Gen. Amer. Trans. Corp.

FREIGHT-CAR INQUIRIES

Louisiana & Arkansas	50, 75 or 100	70-ton hopper	.....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Atlantic Coast Line	17	Coaches	Edw. G. Budd Mfg. Co.
Chicago & North Western, Union Pacific, Southern Pacific	17[3]		Pull.-Std. Car Mfg. Co.
Chicago & North Western, Union Pacific	17[3]		Pull.-Std. Car Mfg. Co.
Southern Pacific	51[3]		Pull.-Std. Car Mfg. Co.

[1] For operation between Chicago and San Francisco, Cal., and Los Angeles on a 39¾ hr. schedule. To cost more than $4,000,000. One, the City of San Francisco will be jointly owned and operated by the Chicago & North Western, the Union Pacific and the Southern Pacific and the second by the North Western and the Union Pacific. Each of the Diesel locomotives will have 6,000 hp. consisting of three 2,000 hp. units. Except for minor differences in available Pullman accommodations, the four trains will be identical. All cars of the new trains will be of aluminum-alloy construction and of the same general contours as the streamliners developed by the three railroads for their transcontinental service, with modifications to make for more effective streamlining. The color design of the trains provides for a harbor mist gray roof, with the sides an armour yellow, trimmed with scarlet-red striping and lettering. Fluorescent lighting will be used in the club and lounge cars, the diners and chair cars. All cars will be self-contained as to air-conditioning and lighting. The trains will be equipped with inter-communicating telephone systems and will have electric heat in addition to the regular steam heat.

[2] Authorized by the Federal District Court under a 15-year lease-purchase plan. During the remainder of 1940, 500 48-ft. drop end gondola cars and 500 40-ft. drop bottom gondola cars will be reconditioned in North Western's shops.

[3] Lightweight streamlined passenger train cars. Some of these cars will be used for re-equipping the "Larks," operating between San Francisco, Cal., and Los Angeles. The new consist of the Larks will also include 26 new lightweight Pullman sleeping cars with drawing room, bedroom, and roomette accommodations. The balance of the 51 cars will be used on the noon "Daylights" to incorporate refinements in design of the more recently built morning Daylights; on the "San Joaquins;" on the "Coaster;" on the "Californian," between Chicago and Los Angeles; on the "Sunset" between San Francisco and New Orleans; and on the "San Francisco Challenger" and the "Pacific Limited" between Chicago and San Francisco.

Stoker Order Exemption Sought by N. Y. O. & W.

THE New York, Ontario & Western has asked the Interstate Commerce Commission to postpone the operation of its recent order requiring all locomotives in heavy freight service to install or be equipped with automatic stokers in so far as it affects 26 of its 184,000 lb., hand-fired, coal-burning locomotives. The petition of the road points out that the installation on these locomotives would cost $78,000 and that such an installation would be "economically unsound and wasteful" in view of the fact that they have been in service for some 30 years.

19,765 New Freight Cars on Order August 1

CLASS I railroads on August 1, 1940, had 19,765 new freight cars on order, according to the Association of American Railroads. On July 1, 1940, they had 16,933 on order, and on August 1, last year, there were 8,473. The new cars on order on August 1, this year, included 11,565 box, 7,218 coal, 360 stock, 250 flat, 50 refrigerator and 322 miscellaneous cars.

Class I roads on August 1, this year, also had 168 new locomotives on order, of which 115 were steam and 53 electric and Diesel-electric. On July 1, 1940, there were 124 new locomotives on order, of which 97 were steam and 27 were electric and Diesel-electric. New locomotives on order on August 1, last year, totaled 118 which included 72 steam and 46 electric and Diesel-electric.

In the first seven months of 1940, the railroads put in service 40,416 new freight cars compared with 10,302 in the same period last year. Of the total number of new freight cars placed in operation in the first seven months of this year, there were 18,640 box, 19,876 coal, 606 flat, 595 refrigerator, 88 stock and 611 miscellaneous cars. In the first seven months this year, the railroads also put in service 201 locomotives, of which 58 were steam and 143 electric and Diesel-electric. Installed in the first seven months last year were 139 new locomotives, of which 20 were steam and 119 electric and Diesel-electric.

Freight cars and locomotives leased or otherwise acquired are not included in the above figures.

W. P. Chrysler Dies at 65

WALTER P. CHRYSLER, who left railroad service after 20 years service to enter the automobile manufacturing industry and became one of its leading executives, died at his home in Great Neck, N. Y., of a cerebral hemorrhage on August 18 at the age of 65. Born the son of a Union Pacific locomotive engineer, Mr. Chrysler entered railroad service in 1892 at the age of 17 as a machinist's apprentice in the Union Pacific enginehouse at Ellis, Kan. Later he was made a general foreman in the Colorado & Southern shops at Trinidad, Colo. After some years as a journeyman machinist he worked with several Western roads as a general foreman and master mechanic. He was appointed superintendent motive power and machinery of the Chicago Great Western in 1908 at the age of 33.

Two years later Mr. Chrysler went into the locomotive manufacturing business as assistant manager of the Pittsburgh Works of the American Locomotive Company, becoming manager the following year. In 1912 he forsook the railroads and their equipment suppliers to join the Buick Motor Company as works manager. He rose rapidly in the automobile business, becoming president of Buick and in 1920 taking over the management of the Willys-Overland Company. He brought out his own car later and made the Chrysler Corporation one of the "big three" in automobile manufacturing. Mr. Chrysler was a director of the New York Central at the time of his death.

C. & N. W. Shop Foremen's Status

BECAUSE the American Railway Supervisors Association, Inc., has withdrawn the petition which instigated the proceeding, the Interstate Commerce Commission has discontinued that phase of its Ex Parte No. 72 (Sub-No. 1) investigation which had to do with the status under the Railway Labor Act of general foremen in the motive power and car departments of the Chicago & North Western.

Monopoly Charge Denied by Pullman

THE Pullman group of companies has not violated and is not now violating any law of the United States, according to D. A. Crawford, president of Pullman, Inc., in a second quarter statement sent stockholders on August 6. The Department of Justice on July 12, as reported in the August *Railway Mechanical Engineer*, filed a complaint in the federal district court at Philadelphia, Pa.

"The action," the report to stockholders said, "attacks a business which during its long history since incorporation in 1867 has developed naturally into the present large-scale operation, as the result of economic forces and in response to the demand of the railroads and the public for sleeping car service on a unified nationwide basis that could best be rendered by the Pullman system of pooled operation. The provision in connection with this extensive travel service, of facilities for the manufacture of standardized and well-adapted equipment under the advantageous condition of concentrated production, is a further natural development that began early in the history of the business and parallels similar provision by many railroads and other public utilities.

"The bill of complaint filed in this case is incorrect in many statements alleged to be fact, and is wholly mistaken in its allegations with respect to the spirit and manner in which the Pullman manufacturing and car-operating businesses have been conducted for so many years. There has been no change of principle or practice in the conduct of either of these businesses following the introduction in recent years of new types of equipment and new methods of passenger transportation, and there is no warrant for this present belated action except as it may be found in an apparent general assault upon large-scale business under the federal anti-trust laws.

"While experience has indicated the advisability of presenting in court, rather than in a publicity contest with a government agency, the defense against legal attacks of this kind, it is nevertheless desirable that stockholder-owners of the assailed companies be informed that the basic allegation of restraint of trade made by the Department of Justice in this case, depending upon the assertion that Pullman has used its contract relations with the railroads to discourage or prevent the introduction of modern types of lightweight passenger equipment is clearly disproved by the record facts that Pullman—(a) Has furnished to the railroads several hundred lightweight sleeping cars of the most modern type, (b) has employed more than $25,000,000 of its resources in financing the investment required to place this new equipment in service, (c) has sought vigorously to extend such improved service on the railroads, and (d) today has additional supplies of such equipment in the course of manufacture or on hand awaiting assignment to the railroads.

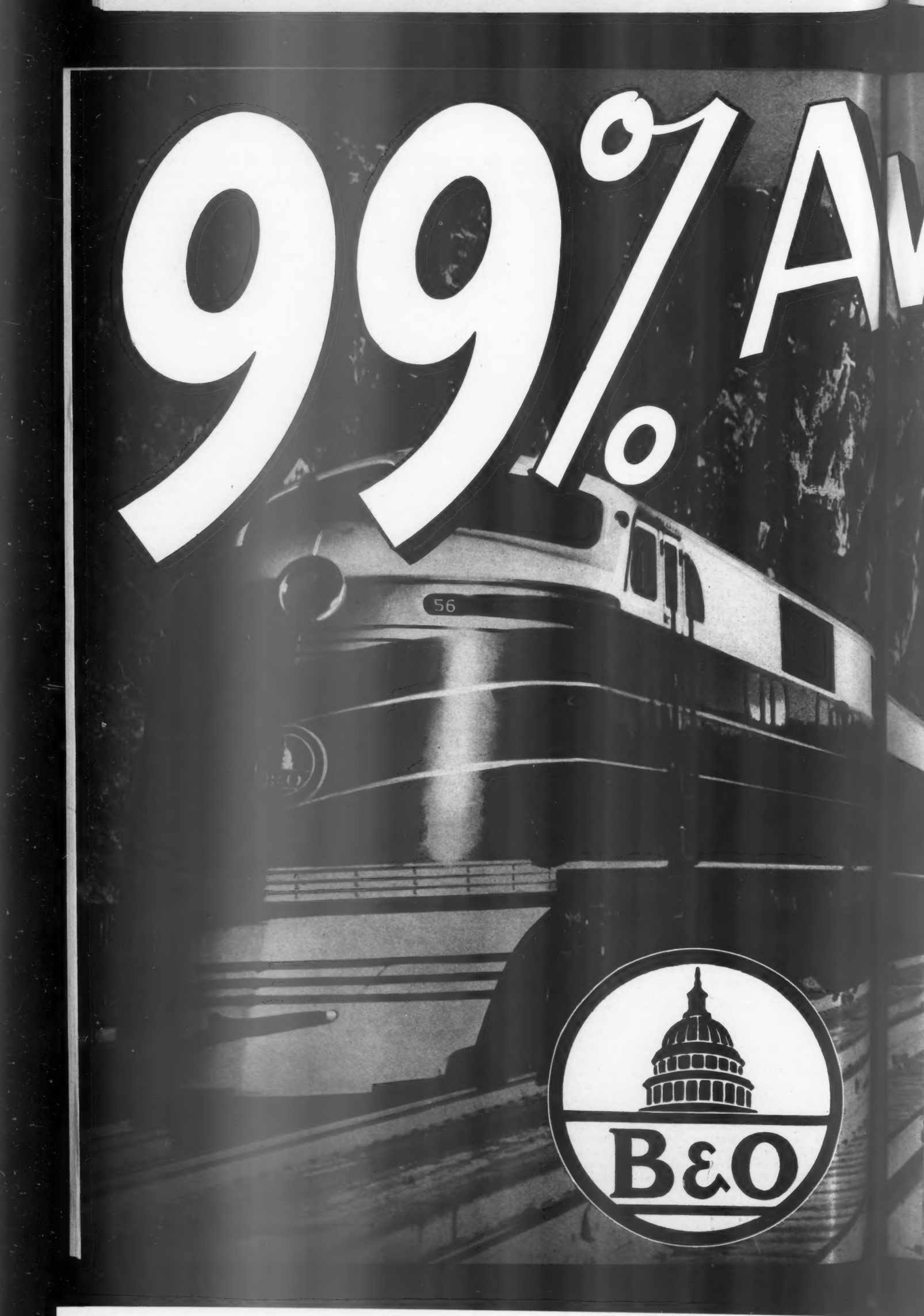
"Concurrently the Pullman-Standard Car Manufacturing Company pioneered in the development of lightweight passenger car structures, built the first practicable separate cars and unit trains of that type, and thereafter has continued the development and encouraged the purchase and use of such equipment by the railroads, with the result that it has built more of the modern widely-accepted types of such passenger equipment than any other carbuilding concern. This whole charge, that the Pullman group of companies has obstructed or grudgingly permitted the development and use of modern lightweight passenger equipment, falls to pieces when subjected to the impact of fact.

"It is the considered opinion of the management and counsel of the Pullman group of companies, that these companies have not violated and are not now violating any anti-trust or other law of the United States; and further, that this suit will be successfully defended and should not therefore occasion anxiety to stockholders."

"Head End" Safety Poster

LITERATURE for the September installment of the A. A. R.'s "All the Year-Every Year Safety Program" deals with safety as applied in the locomotive cab. The large poster for public display points out that "A careful 'head-end' crew is a good start for a safe trip," while the accompanying circular contains a series of safe procedures as applied to the locomotive cab. The material, much of which was contributed by G. F. Baker, road foreman of engines, Atlantic Coast Line, covers such factors as proper bracing while handling stoker slides, the possibilities of accidents in connection with grate shaker arms, safe footing while oiling machinery, climbing out of cab windows and other routines peculiar to the head-end.

(*Turn to second left-hand page*)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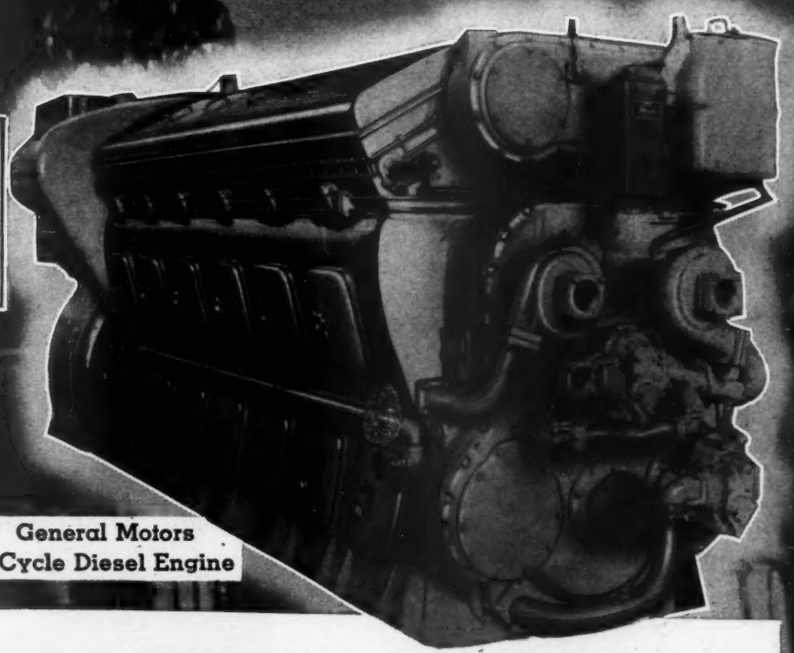
B&O

Availability

SIX B.&O. DIESELS OPERATE 3,441,916 MILES IN PASSENGER SERVICE

GM
GENERAL MOTORS
DIESEL POWER



General Motors
2-Cycle Diesel Engine

SIX 3600 Hp. EMC Diesel passenger locomotives entered service on the Baltimore and Ohio—two in May and June, 1937, two in January, 1938, two in June, 1938. Up to June 30, 1940, these locomotives have operated 3,441,916 miles with an average availability of 95.5 per cent. Diesel locomotive No. 56 on the Capitol Limited, which operated every day for an entire year without missing a trip, has to its credit 515,485 miles with 99.3 per cent availability.

Typical of EMC Diesel performance, these records are being made in fast passenger service without excessive top speeds but with high average speed consistent with safety, passenger comfort, and minimum wear on rolling stock and track. No other type of motive power can equal this performance.

ELECTRO-MOTIVE CORPORATION

SUBSIDIARY OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S. A.

Supply Trade Notes

JOHN E. WRIGHT has been appointed sales agent for American Steel Foundries, at St. Louis, Mo., succeeding Walter C. Doering, vice-president, deceased.

◆

R. G. JUSTUS, representative for the Westinghouse Air Brake Co. in the Southwestern district, with headquarters at St. Louis, Mo., has been appointed manager of industrial sales at Wilmerding, Pa.

◆

WILLIAM H. HECKMAN, sales representative of the T-Z Railway Equipment Company, Chicago, has been appointed sales engineer of the Sargent Company, Chicago.

◆

ROBERT G. ALLEN, formerly sales manager of the Walworth Company, Greensburg, Pa., has been elected president and a director of the Duff-Norton Manufacturing Company, Pittsburgh.

◆

WILLIAM C. TYLER, formerly mechanical engineer and superintendent of the manufacturing division of the William E. Pratt Manufacturing Company, has been appointed chief mechanical engineer of the Klasing Car Brake Company, Joliet, Ill.

◆

A. A. ORTEGA, who has been sales engineer for the Magor Car Corporation, with headquarters at Havana, Cuba, since 1923, has been appointed export sales manager, with headquarters at New York, to head the export department recently created by the corporation. He was born in Santiago de Cuba, Cuba, on September 1, 1888, was educated at schools in Cuba and at Delaware Academy, Delhi, N. Y., and was graduated with a civil engineering degree from Rensselaer Polytechnic Institute, Troy, N. Y., in 1913. Until 1919 Mr. Ortega was on location and construction work on railroads and highways in Cuba and the Dominion Republic. In the latter year he joined the staff of A. M. Puente & Co., agents at Havana for Magor Car Corporation, and in 1923 went directly with Magor as sales engineer.

A. A. Ortega

◆

R. VOLBRECHT has been appointed to the New York merchandising sales staff of Cutler-Hammer, Inc.

◆

UNITED STATES STEEL CORP. OF DELAWARE.—*G. Cook Kimball,* executive vice-president of the United States Steel Corporation of Delaware, at Chicago, will temporarily make his headquarters at Washington, D. C., effective August 15, in the interest of further co-ordinating United States Steel activities arising from increasing requirements of the national defense program. During his temporary absence from Chicago, *C. H. Rhodes,* vice-president, will take over the activities and duties which have been under Mr. Kimball's direction.

◆

OKADEE CO.-VILOCO RAILWAY EQUIPMENT CO.—*Charles G. Leoarned,* vice-president of the Okadee Company, and the Viloco Railway Equipment Company, Chicago, has also been placed in charge of sales and has been elected vice-president in charge of sales of the Viloco Machine Company, Benton Harbor, Mich., the manufacturing subsidiary, with headquarters in Chicago. *Curtiss W. Ploen,* mechanical engineer, has been elected vice-president in charge of manufacturing and engineering, and *B. B. Rich,* treasurer, has been elected treasurer and comptroller.

◆

SAMUEL M. FELTON, whose appointment as Eastern sales manager of the railroad division of the Edward G. Budd Manufacturing Company was recently announced, was born in Cincinnati, Ohio, in 1893, the son of the late S. M. Felton, who was president of the Great Western from 1909 to 1925, and chairman of the board until his death in 1930. He was graduated from Harvard University in 1916 and in 1917 went overseas with the 13th Engineers, the regiment which operated the Verdun military railways, and later became adjutant in the U. S. Engineering Brigade with the British Third Army, in connection with the operation of trench tramways.

Samuel M. Felton

On his return from overseas, Mr. Felton joined the Pure Oil Company, and rose successively through various positions to become general manager of the Eastern division. He was associated with the White Motors Company from 1926 to 1935, when he joined the Budd organization.

Obituary

HERBERT W. WOLFF, senior vice-president in charge of sales, American Car and Foundry Co., with headquarters at New York, died on July 27, at his summer home at Grayling, Mich., at the age of 66, after an illness of a year's duration. Mr. Wolff was born in Hamilton, Ont., on December 27, 1873, and received his early education in the public schools of Detroit, Mich. He began his business career with the Michigan Car Company in Detroit, which company was later consolidated with the Peninsular Car Company under the title Michigan-Peninsular Car Company.

At the time of the organization of the American Car and Foundry Co. in 1899, Mr. Wolff went to St. Louis, Mo., as chief mechanical engineer of the new corporation. In 1912 he was appointed assistant to vice-president and in 1916 was elected vice-president in charge of sales in the Chicago district. During the World War period Mr. Wolff spent a great deal of time in Washington, D. C., working with the United States Railroad Administration and the Military Railways Division of the War Department in co-ordinating industrial facilities. In 1925, Mr. Wolff was elected a director of A.C.F. and in the same year was made executive head of sales of the entire corporation, with office in New York. In 1935 he was appointed senior vice-president of the company, the position he was holding at the time of his death.

Herbert W. Wolff

Personal Mention

General

H. S. KELIN has been appointed mechanical engineer of the Union Railroad, with headquarters at East Pittsburgh, Pa.

F. R. DENNEY, master mechanic of the Texas & Pacific, at Shreveport, La., has been promoted to assistant mechanical superintendent, with headquarters at Dallas, Tex.

HARRY REES, district master mechanic of the Baltimore & Ohio at Cincinnati, Ohio, has been appointed superintendent of motive power of the western lines, with headquarters at Cincinnati. Mr. Rees was born on September 30, 1885, and entered B. & O. service as a machinist at New Castle, Pa., on September 4, 1913. He became foreman on September 1, 1917; assistant master mechanic, on November 16, 1917, and general foreman on March 15, 1919. On May 1, 1920, he became general foreman at Garrett, Ind., and general foreman at New Castle Junction, Pa., on July 1, 1926. On April 15, 1927, he was appointed master mechanic at Akron, Ohio, and became division master mechanic, with headquarters at Akron, on February 1, 1932. On December 1, 1936, Mr. Rees was appointed district master mechanic at Cincinnati.

Master Mechanics and Road Foremen

J. E. FRIEND, master mechanic of the Texas & Pacific at Big Spring, Tex., has been transferred to Fort Worth.

F. L. HALL, superintendent of shops of the Baltimore & Ohio at Ivorydale, Ohio, has recently been appointed master mechanic with headquarters at Cincinnati.

T. L. PREUN, assistant master mechanic of the Philadelphia division of the Pennsylvania, with headquarters at Harrisburg, Pa., has been appointed master mechanic of the Northern division.

WILLIAM C. SMITH, who has been appointed master mechanic of the New York, New Haven & Hartford at New Haven, Conn., as announced in the June issue, was born in New York City on September 22, 1896. He attended high school in New York and in January, 1915, entered the service of the N. Y. N. H. & H. as a machinist helper. From April, 1917, until November, 1919, Mr. Smith served in France with the A. E. F. He returned to the N. Y. N. H. & H. in December, 1919, as a machinist. He served in the mechanical engineering department from January, 1921, until September, 1923, when he was appointed mechanical inspector, supervisor of pit inspection and chief mechanical inspector, respectively. In July, 1939, he was promoted to the position of assistant master mechanic. He was appointed master mechanic in April, 1940.

H. C. VINSANT, master mechanic of the Texas & Pacific at Ft. Worth, Tex., has been transferred to Marshall.

H. J. BURKLEY, master mechanic of the Baltimore & Ohio at Cincinnati, Ohio, has become district master mechanic with the same headquarters.

PAUL THOMAS, assistant master mechanic of the Panhandle division of the Pennsylvania, with headquarters at Mingo Junction, Ohio, has been transferred to the Philadelphia division.

C. H. SPENCE, district motive power inspector of the Baltimore & Ohio at Baltimore, Md., has been promoted to master mechanic with headquarters at Du Bois, Pa.

JOHN E. DAVIS, who retired on July 1 as master mechanic of the Chesapeake & Ohio at Columbus, Ohio, was born in Dover, England, on January 16, 1869. He entered railway service on April 1, 1882, as a messenger in the mechanical department shops of the Grand Trunk, now the Canadian National, at Stratford, Ont. He later served as a machinist apprentice and machinist at Stratford, in April, 1890, moving to Port Huron, Mich., where he became a machinist on the Chicago & Grand Trunk, now the Grand Trunk Western. He became gang foreman on June 1, 1896, and erecting shop foreman on April 1, 1899. He became general foreman of the Baltimore & Ohio at Newark, Ohio, on April 1, 1903, and master mechanic at Garrett, Ind., on January 1, 1904. He went to Hoisington, Kan., on November 1, 1906, as general foreman of the Missouri Pacific, and on August 1, 1907, returned east as general foreman of the Hocking Valley, now the Chesapeake & Ohio, with headquarters at Columbus, Ohio. He was appointed master mechanic at Columbus on October 1, 1910.

John E. Davis

Purchasing and Stores

FRANK STEARNS AUSTIN, assistant purchasing agent of the New York Central, has been appointed purchasing agent, with headquarters as before at New York, succeeding Charles C. Warne, deceased.

Obituary

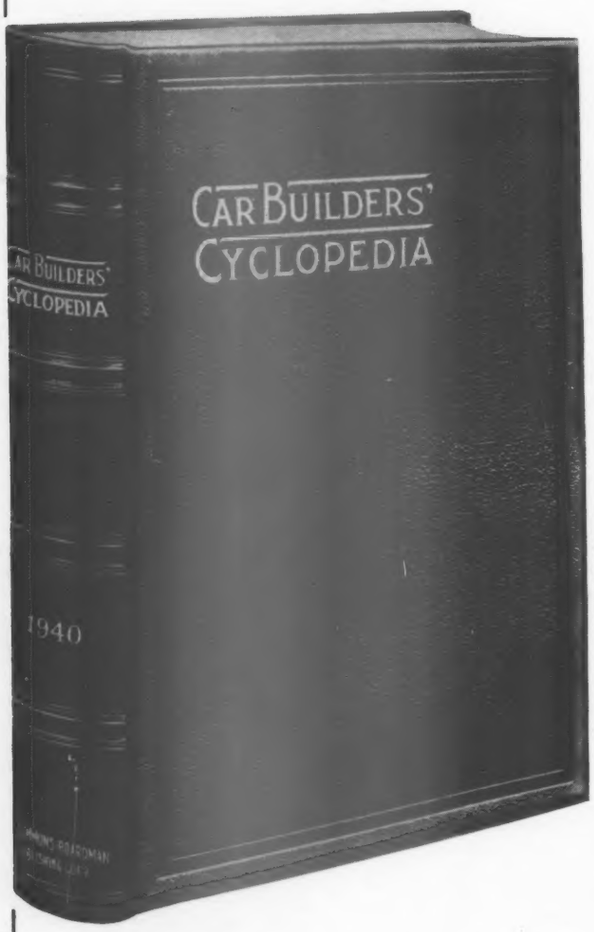
ALONZO PACK, who was chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission, between 1918 and 1935, died at Denver, Col., on August 14, at the age of 76. He entered railroad service as a boilermaker in 1882 and between 1887 and 1893 served as locomotive fireman. Between 1893 and 1911 he was employed as a locomotive engineer. In 1911 he entered the service of the Interstate Commerce Commission bureau as district supervisor. In 1914 he was appointed assistant chief inspector of the bureau. In July, 1918, he was appointed chief inspector. Mr. Pack retired from service on July 31, 1935, and was succeeded by John M. Hall.

Mr. Pack took over the leadership of the bureau at a time when the condition of motive power of the country was at a low ebb and inspector-personnel depleted by transfer to other activities. He succeeded in building up the organization and expanding its services in line with broadened jurisdiction given to it by amendments to the original Locomotive Inspection Act. In 1932 the bureau reported the best condition of locomotives in service and the lowest accident rate ever recorded.

Alonzo Pack

Mr. Pack was a conference member of the Boiler Code Committee of the American Society of Mechanical Engineers. He was later appointed by the Society to serve on a special committee considering fusion welding. He was also a member of the sub-committee to investigate and report with respect to the practicability of cold flanging of steel boiler plate.

Announcing the 15th Edition of the



CAR BUILDERS' CYCLOPEDIA

Ready October 15th

Completely revised and enlarged to include an expanded Car Shops Section, the Fifteenth Edition of the CAR BUILDERS' CYCLOPEDIA of American Practice will be off the press on or about October 15th. It will contain some 1400 pages, 3000 scale drawings and photographs, measure 9 x 12 x 3 inches, and weighs nine pounds. The price in buckram binding will be $5.00, and in full leather, $7.00, postpaid.

Since 1879 this cyclopedia has been recognized as the standard authority wherever American made rolling stock is in use. It is a one-volume library of up to date technical information on all kinds of railway cars and their equipment, and on maintenance methods and car shop equipment.

Editorial Staff

The editor of the CAR BUILDERS' CYCLOPEDIA is Roy V. Wright, Managing Editor of "Railway Age." The managing editor is Robert C. Augur, Associate Editor of "Railway Mechanical Engineer." An advisory committee of the Association of American Railroads, Mechanical Division, is composed of: W. I. Cantley, Mechanical Engineer, A.A.R. Mechanical Division; T. P. Irving, Engineer of Car Construction, Chesapeake & Ohio Railway; and H. W. Faus, Engineer of Motive Power, New York Central System.

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